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VOL. CXLIII.—No. 3710] LONDON: FRIDAY EVENING, FEBRUARY 18, 1927 [PRICE ONE SHILLING BY IRELAND POST 1s. 3d.

PUBLIC NOTICES

HEATING, &c.
TO BUILDERS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 4th March, 1927, for ACCELERATED LOW-PRESSURE HOT WATER HEATING and SUPPLY at the "Metropolitan" Telephone Exchange, Wood-street, E.C. Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea (cheques payable to the Commissioners of H.M. Works, &c.). The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 4747

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
ABOUT 6300 TONS OF BRIDGEWORK.
Tenders due on the 22nd March, 1927.
Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 4799

Air Ministry.
DIRECTORATE OF SCIENTIFIC RESEARCH.
A JUNIOR SCIENTIFIC OFFICER is REQUIRED at the Royal Aircraft Establishment, primarily for work in physics, particularly on problems arising in connection with high-altitude flying.
Candidates should have an Honours Degree in Natural Science or Mechanical Science, and must be medically fit for flying and willing to fly as observer.
Salary £175-£15-£235 plus Civil Service bonus per annum, giving a present total starting remuneration of £265 18s. per annum.
Preference given, other things being equal, to an ex-Service man.
Application should be made in a form to be obtained from the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants, to whom it must be returned, quoting reference No. A. 107, not later than 9th March, 1927. 4769

University College of South WALES AND MONMOUTHSHIRE.
COLEG PRIFATHROFAOL DEHEUDIR CYMRU A MYNWY.
6-INCH ORDNANCE MAPS.
The College REQUIRES 6in. ORDNANCE MAPS of Wales and the Border (excluding the Counties of Glamorgan and Monmouth). ANY person desirous of disposing of second-hand sets of maps at a reasonable price is requested to communicate with the undersigned.
D. J. A. BROWN,
Registrar.
University College,
Cathays Park, Cardiff. 4770

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that EDWARD LIONEL JOSEPH, of 96, Victoria-street, in the City of Westminster and County of London, S.W. 1, a British subject, SEEKS LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 222,385, granted to him for an invention entitled "Improvements in or relating to Filters for Air and other Gases."
Particulars of the proposed amendment were set forth in the Illustrated Official Journal (Patents) of 9th February, 1927.
Any person, or persons, may give Notice of Opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
W. S. JARRATT,
P2785 Comptroller-General.

Ashborne Urban District COUNCIL.
RODSLEY WATER SCHEME.—CONTRACT NO. 4.
PUMPING MACHINERY.
The Council invite TENDERS for the complete INSTALLATION of a HIGH-CLASS PUMPING PLANT in DUPLICATE.
Each unit will comprise a Vertical Crude Oil Engine driving through gearing a Combined High-lift Vertical Centrifugal Bore-hole and Force Pump, to raise 12,500 gallons per hour against a head of 437ft. including friction, together with all Accessories, &c., to make the plant complete in every detail.
The work will also include subsidiary Plant, including Depth Recorders, Venturi Meter, Heating Apparatus and General Equipment.
Four-stroke cycle vertical engines are specified, but manufacturers may submit alternative Tenders for two-stroke cycle engines.
Copies of the conditions, specification, schedule of prices and form of Tender, prepared by the Engineer, Dr. Herbert Lapworth, M. Inst. C.E., 25, Victoria-street, Westminster, may be obtained on application to the undersigned on or after February 10th, 1927. The application must be accompanied by a sum of £5, which will be refunded on return of the documents within seven days or after the receipt of a bona fide Tender and the documents required.
Facilities for examining the drawings, for inspecting the site and general information can be obtained on application to Mr. D. Powell, M. Inst. M. and Cy E., Surveyor to the Council, Council Offices, Ashborne, Derbyshire.
Tenders are to be sent on the form supplied, and with the annexed documents must be enclosed in a sealed cover, endorsed "Rodsley Water Scheme: Tender for Contract No. 4," addressed to and reaching the undersigned not later than 10 a.m. on Monday, March 21st, 1927.
Only Tenders for vertical engines and from experienced oil engine and pump manufacturers will be considered.
The Council do not bind themselves to accept the lowest or any Tender.
R. WILLIAMS,
Clerk to the Council.
Council Offices,
Ashborne, Derbyshire,
February 1st, 1927. 4708

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—
4 BOILERS for LOCOMOTIVES (Broad Gauge).
Tenders are due in on Tuesday, 8th March, 1927, by 2 p.m.
Tender forms obtainable at above address; fee One Guinea, which is not returnable.
The Directors do not bind themselves to accept the lowest or any Tender. 4768

The Engineer

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PUBLIC NOTICES

B. & C.I. Railway Company. The Directors are prepared to receive up to Noon on Wednesday, 9th March, 1927, TENDERS for the SUPPLY of :—
PATENT GLAZING, ROLLER SHUTTER DOORS and STEEL SASHES.
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of £1 each (which will not be returned).
The Directors do not bind themselves to accept the lowest or any Tender.
S. G. S. YOUNG,
Secretary.
Offices: The White Mansion,
91, Petty France, Westminster, S.W. 1,
14th February, 1927. 4767

County Borough of Belfast. TO BORING CONTRACTORS.
The Belfast Corporation invite TENDERS from competent Boring Contractors for the SINKING of SIX BORE-HOLES in connection with the construction of proposed Culvert from River Blackstaff to River Lagan, in positionsshown on plan.
Copies of the plan, specification, general conditions and form of Tender with special envelope, may be obtained from the City Surveyor, City Hall, Belfast.
Sealed Tenders, on forms provided, and enclosed in the special envelopes, endorsed with the name and address of the tenderer, and marked "Borings," to be delivered in the office of the undersigned before Twelve o'clock Noon on Tuesday, 1st March, 1927.
An official receipt must be obtained for every Tender delivered by hand. Tenders sent by post must be registered. The lowest or any Tender will not necessarily be accepted.
Parties tendering must comply with the Council's Standing Orders relating to wages, hours of labour, &c.
4756 R. MEYER, Town Clerk.

The Bengal and North-Western RAILWAY COMPANY, LIMITED.
The Directors are prepared to receive TENDERS for the SUPPLY of—
FOUR LOCOMOTIVE TANK ENGINES,
as per specification to be seen at the Company's Offices.
Tenders, addressed to the undersigned, and marked "Tender for Loco. Tank Engines," with name of firm tendering, to be lodged not later than Noon on the 4th day of March, 1927.
For each specification a fee of £1 will be charged, which cannot under any circumstances be returned.
The Directors do not bind themselves to accept the lowest or any Tender.
By Order of the Board,
W. R. IZAT,
Managing Director.
238, Gresham House, Old Broad-street,
London, E.C. 2, 10th February, 1927. 4753

PUBLIC NOTICES

Metropolitan Borough of St. PANCRAS.
PRINCE OF WALES-ROAD PUBLIC BATHS.
TENDERS are INVITED for the SUPPLY and ERECTION of a NEW STEAM ENGINE and BORE-HOLE PUMP, capable of lifting 10,000 gallons per hour, together with the necessary alterations to the buildings.
Specification, form of Tender and drawings may be seen at the offices of the Electrical Engineer, 57, Pratt-street, Camden Town.
Tenders to be sent in on or before Noon on Friday, 4th March, 1927, addressed to F. V. Creed, Esq., Town Clerk, Town Hall, Pancras-road, N.W. 1, and endorsed "Tender for Steam Engine and Bore-hole Pump."
F. V. CREED, Town Clerk.
Town Hall, Pancras-road, N.W. 1. 4760

Royal State Railways of Siam. NOTICE.
SEALED TENDERS for the SUPPLY of AXLE-BOXES, BEARING SPRINGS and AXLE GUARDS for GOODS ROLLING STOCK, B.E. 2470, will be received by the Administration of the Royal State Railways of Siam, Bangkok, until Fourteen o'clock on the 14th May, 1927, at which place and hour the Tenders will be publicly opened and read.
Blank Tender forms, general conditions, specifications and drawings may be obtained from Messrs. SANDBERG, 40, Grosvenor-gardens, London, S.W. 1, upon payment of £1 per set, which sum will not be refunded.
Right is reserved to reject any or all Tenders, and to accept any Tender which is to the best interests of the Royal State Railways of Siam. 4771

State Electricity Commission OF VICTORIA, AUSTRALIA.
TENDERS are hereby INVITED for the MANUFACTURE, SUPPLY and DELIVERY for the Yallourn Brown Coal Works, Victoria, Australia, of OVERBURDEN DUMP TRUCKS, in accordance with Specification No. 27/9.
Copies of Tender form, specification, &c., will be available upon application to :—
The Agent-General for Victoria,
Victoria House, The Strand,
London, England.
CHARGE.—£2 for three copies of Tender form, conditions of contract and specification complete. This charge will be returned in the event of a bona fide Tender being received. Extra copies 10s. each, not returnable.
PRELIMINARY DEPOSIT.—A preliminary deposit of £50 is to be lodged at the office of the Agent-General for Victoria.
Tenders, on prescribed form, properly endorsed and addressed, must be delivered at the office of the Commission, Melbourne, not later than 4th April, 1927.
The Commission does not bind itself to accept the lowest or any Tender.
R. LIDDELOW,
4721 Secretary.

PUBLIC NOTICES

City of Nottingham.
The Works and Ways Committee are prepared to receive TENDERS for the SUPPLY of the UNDERMENTIONED STORES and MATERIALS, the contracts to commence on the 1st April, 1927, and to terminate on the 31st March, 1928—

A	Coal.
B	Blue Lias Lime.
C	Red Bricks.
D	Blue Bricks.
E	Timber.
F	Stoneware Pipes, &c.
G	Stoneware Pipes, &c. (patent joints).
H	Iron Castings, Iron Gullieys, &c.
I	Yorkshire Flags, Kerb, &c.
J	Granite Setts, Kerb and Broken Granite.
K	Ironstone Slag, Chippings, &c.
L	River Gravel.
M	Concrete Sewer Tubes.
N	Picks, Shovels, Scoops, &c.
O	Ironmongery.
P	Scavenging and other Brushes.
Q	Limestone Chippings.
R	Refined Tar.
S	Pitch.
T	Creosote Oil.

Forms of Tender may be obtained on applying to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of 5s. each, which will be returned on receipt of a bona fide Tender in accordance with the specifications, providing such Tender is not withdrawn and is delivered by the time stated below.
Patterns and samples may be inspected at the Eastcroft Depot, London-road, Nottingham.
The Committee will not consider any Tender except on the authorised form of Tender, which must be delivered to the undersigned, in the official envelope provided, on or before Thursday, 3rd March, 1927.
The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from persons who conform to the conditions as regards paying the local standard rate of wages, &c., and to the working rules of the Nottingham district, applicable to the various trades.
By Order,
W. J. BOARD,
Town Clerk.
Guildhall, Nottingham,
7th February, 1927. 4741

County Borough of Brighton. WATERWORKS DEPARTMENT.
PATCHAM PUMPING STATION.
The Corporation invite TENDERS for the MANUFACTURE, DELIVERY, ERECTION, SETTING TO WORK, and MAINTAINING for a period of 12 months, of a TRIPLE-EXPANSION PUMPING ENGINE, WELL and FORCE PUMPS, LANCASHIRE BOILERS, SUPERHEATERS, ECONOMISER, and AUXILIARY PLANT at the above Works. The Engine to be of a capacity of 3½ million gallons per 24 hours.
Copies of the drawings, conditions of contract, specification and form of Tender may be obtained from Mr. A. B. Cathcart, M. Inst. C.E., Waterworks Engineer, 12, Bond-street, Brighton, after the 16th inst., upon receipt of a deposit of £5 5s., which will be refunded upon the submission of a bona fide Tender and the return of the documents.
Sealed Tenders, endorsed "Tender for Pumping Engine, &c., Patcham Works," must be delivered at the office of the undersigned, Town Hall, Brighton, not later than 10 a.m. on March 14th, 1927.
The Corporation do not bind themselves to accept the lowest or any Tender.
JAS. H. ROTHWELL,
Town Clerk.
Town Hall, Brighton,
9th February, 1927. 4723

Western Australia.—Applications are INVITED by the Agent-General for Western Australia for JUNIOR ASSISTANT CIVIL ENGINEERS for the Public Works Department of the Western Australian Government. Applicants must have had good theoretical training, some practical experience under a qualified civil engineer, and have passed Sections A and B of the Examination of the Institution of Civil Engineers or hold a degree exempting them from such examination.
Applications from those not holding the above qualifications will not be considered.
Applications will close on the 28th March, 1927.
Copies of the conditions of appointment can be obtained from the AGENT-GENERAL FOR WESTERN AUSTRALIA, Savoy House, Strand, London, W.C. 2. 4781

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PUBLIC NOTICES

Civil Service Commission.
POST VACANT.

HYDRO-ELECTRIC DEVELOPMENT OF THE RIVER SHANNON.

APPLICATIONS are INVITED from experienced Engineers for a POST as STRUCTURAL ENGINEER on the Civil Engineering Staff for the above Constructional Works. The remuneration attaching to the post will be £300 per annum inclusive, with possible increases to £400 per annum inclusive.

The appointment, which will be temporary, non-pensionable, and subject to a month's notice on either side, will be made by the Minister for Industry and Commerce on the recommendation of the Civil Service Commissioners, with the assistance of a Board of Selection set up by the Commissioners.

Applicants may be required to attend in person before the Board, and it will be necessary for the successful candidate to satisfy the Commissioners as to health and character.

Further particulars and also form of application obtainable from the SECRETARY, Civil Service Commission, 33, St. Stephen's Green, Dublin. Completed forms of application will be received up to, but not after, first post 11th March, 1927.

82/H5289. W. H. Co. 4774

Civil Service Commission.
DEPARTMENT OF INDUSTRY AND COMMERCE.

HYDRO-ELECTRIC DEVELOPMENT ON THE RIVER SHANNON.

POST VACANT.

APPLICATIONS are INVITED from experienced engineers for the following POST on the Mechanical Staff in the Erection of the Hydraulic Equipment of the Power Station :—

MECHANICAL ENGINEER.

Inclusive salary £600, with probable increases to £700 per annum. Candidates must hold a University Degree in Mechanical Engineering or an equivalent qualification, and must have at least 5 years' experience on the erection and tests of heavy hydraulic machinery and equipment (turbines, penstocks, sluices, &c.). Experience in the erection of electrical machinery (not including testing) will be an additional qualification.

The appointment, which will be temporary, non-pensionable, and subject to a month's notice on either side, will be made by the Minister for Industry and Commerce on the recommendation of the Civil Service Commissioners, who will investigate the qualifications of the candidates with the assistance of a Selection Board appointed by the Commissioners.

Further particulars and form of application obtainable from the SECRETARY, Civil Service Commission, 33, St. Stephen's Green, Dublin. Latest date for receiving application 1st March, 1927.

82/H5295. W. H. Co. 4773

Municipality of Singapore.
STRAITS SETTLEMENTS.
MUNICIPAL ENGINEER'S DEPARTMENT.
APPOINTMENT OF ASSISTANT ENGINEER.
ADVERTISEMENT.

The Municipal Commissioners of Singapore REQUIRE an ASSISTANT ENGINEER for their Municipal Engineer's Department, age 23 to 28 years, unmarried, on a three years' agreement, with possible extension.

Applicants must have had a good general and technical education, and have served articles or gained experience under a qualified engineer, preferably in a Borough Surveyor's office.

They must have passed an examination qualifying them for Associate Membership of the Institution of Civil Engineers.

Experience in modern road construction and in the maintenance of roads is essential; also ability to control subordinate staff and large labour force. Knowledge of drainage (surface drains and sewers) and acquaintance with the usual routine operations of a Borough Surveyor's Department is desirable.

SALARY.—5400 dollars for the first year, 5700 dollars for the second year, and 6000 dollars for the third year, payable monthly in Straits currency. The value of the dollar is 2s. 4d. sterling, and the pay of the appointment for the first year is therefore £630. An allowance for transport when on duty will be granted. Free passage will be provided with half-pay during the voyage out. The selected candidate must pass an approved medical examination.

Applications, stating whether married or single, age, birthplace, and giving details of education, training and experience generally, with particular reference to the qualifications mentioned above, and accompanied by copies (not originals) of testimonials, to be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 64, Victoria-street, London, S.W. 1, Agents for the Commissioners, not later than Wednesday, 23rd February, 1927.

Further particulars, if desired, can be obtained from the Agents. 4709

Surveyor of Transmission Lines
AND TWO INSPECTORS.

APPLICATIONS are INVITED (by letter only) from properly qualified candidates for immediate APPOINTMENT to the above POSTS in Malaya :—

SURVEYOR.—Applicants must have received a good general and technical education, and have passed the examination for A.M. Inst. C.E., or possess a degree from a recognised engineering college, and be well up in all instrument work, particularly with reference to location for transmission lines. Previous experience in a tropical climate is an advantage, but not essential.

TWO INSPECTORS FOR CIVIL ENGINEERING WORK.—Applicants must be experienced Clerks of Works, thoroughly conversant with general work connected with civil engineering, especially reinforced concrete.

Age for both appointments 30-40 years. Selected candidates will only be appointed subject to passing strict medical examination.

Salary in each case according to age and qualifications. Free first-class passage for the Surveyor, and second-class for the Inspectors to Malaya and home again on satisfactory termination of service.

Applicants must forward details of their career, giving particulars of education (general and technical), practical training and subsequent experience, with names of employers, appointments held and dates of such employment, together with COPIES ONLY of testimonials, &c., to the undersigned as soon as possible, but not later than 25th February, 1927.

RENDEL PALMER AND TRITTON,
Appointments Department,
13, Dartmouth-street, Westminster, S.W. 1.
14th February, 1927. 4762

The Government of Madras
REQUIRE the SERVICES of a
DREDGING SUPERINTENDENT
for Cochin Harbour Works. Must have at least 15 years' practical Dredging Experience, including 5 years as Dredging Master. Good knowledge of Suction Dredging and Reclamation on a large scale specially required. Must be energetic, in robust health and not over 45 years of age.

Three years' agreement. Pay at the rate of Rs. 700 per calendar month. Free passages under the usual rules. Strict medical examination.

Forms of application and further particulars may be obtained, upon request by postcard, from the SECRETARY to the HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications, 10th March, 1927. 4758

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

ENGINEER, MECHANICAL.—HANS RENOLD, Ltd., THANK all APPLICANTS and wish to state that the POSITION has now been FILLED. 4777 A

WANTED for Good Firm in Ceylon, YOUNG ENGINEER, A.M.I.C.E. (Struct.) preferred, with sound practical knowledge of Ferro-concrete Construction, specifications, quantities. Capacity to supervise labour and take responsible charge of all ordinary building operations essential. Good pay and prospects for man of real energy, capacity and initiative. State age, condition, and full details of experience, with references.—Write to "S. F." c/o Street's, 6, Gracechurch-street, E.C. 3. 4752 A

WANTED for Motor Repair Works, ENGINEER, with Works and College Training preferred, age about 25.—Address, giving experience and salary expected, P2805, The Engineer Office. P2805 A

WANTED, METALLURGICAL ASSISTANT, Used to Microscopic Examination of Steels. Works experience and knowledge of Heat Treatment essential. State age, experience, and salary required.—Address, P2787, The Engineer Office. P2787 A

ASSISTANT WORKS MANAGER REQUIRED for Large Electrical Switchgear Factory in Manchester District; must have had wide experience on High-pressure Gear, be good disciplinarian, and able to push work through the factory quickly. State age, experience, and salary required.—Address, 4778, The Engineer Office. 4778 A

CIVIL ENGINEER SALESMAN for London, Home Counties, South and East Coast, preferably with experience of Dock Work and Sales of Pre-cast Concrete and Granite.—Address, with full particulars of age, experience, salary required, 4775, The Engineer Office. 4775 A

CONTRACTORS' AGENT WANTED AT ONCE for Construction of Big Factory in Midlands. Extensive experience in Reinforced Concrete and General Building Work required.—Address, stating age, experience, salary required, &c., 4790, The Engineer Office. 4790 A

DESIGNER REQUIRED IMMEDIATELY in Clyde District for Fine and Accurate Mechanisms. College training desirable. State experience and salary required.—Address, P2800, The Engineer Office. P2800 A

ENGINEER for Designing and Developing Light Printing Machinery. Accustomed to modern methods of interchangeable production. Preference given to man accustomed to engineering buying and placing of contracts for manufacture. Salary £9 to commence. Write in first instance giving experience. Interview and employment Westminster.—Address, P2799, The Engineer Office. P2799 A

ENGINEER SALESMAN WANTED by a Big Company connected with the Petroleum Industry. There are a few vacancies for fully qualified men for employment within the U.K. Engineering experience should embrace knowledge of working conditions of all types of prime movers.

Preference will be given to applicants having a good and progressive sales record.

Application should be made in writing, stating age, experience, and salary required, to Box No. "E," c/o Lord and Thomas, Surrey House, Victoria Embankment, W.C. 2. P2818 A

ENGINEER (30), Sound Technical Training, Fully conversant Boiler-house Plant, knowledge Chemistry advantage, REQUIRED by Makers of Water Softeners, for supervising erection and operation.—Write, stating past experience, salary required, to Box 664, Sells Advertising Offices, Fleet-street, E.C. 4. 4761 A

INSPECTORS.—SEVERAL are REQUIRED for Aero-engine Inspection. Must be capable of examining and reporting on same when stripped down after running tests. Applicants must have had similar experience and be prepared to qualify after training for a Ground Engineer's Certificate.—Address, giving full details of engineering experience, 4779, The Engineer Office. 4779 A

SITUATIONS OPEN (continued)

ENGINEER for Small Repair Works, East London. Gas and oil engine and general repairs, plans, estimates, arrange and supervise work. State salary, age, and experience.—Address, P2804, The Engineer Office. P2804 A

LONDON REPRESENTATIVE REQUIRED for all countries except Europe, for a very important Italian Firm (Tubi Togni-Brescia), which specialises in designs and manufacturing steel pipe lines, also valves and all kinds of apparatus for hydro-electric installations and water supply lines. Useless applying unless of proved technical experience and with best social references.—Write, A. A., Box 955, Dorland's, 14, Regent-street, S.W. 1. P2781 A

MODERN PRODUCTION.—WANTED, Really experienced MAN, Take Charge of Modern Machine Shop, machines producing motor vehicles. Must have had experience in latest practice of Gear Cutting and Gear Grinding, Bar Lathes, Automatics, General and Cylinder Grinding and General Machining of all Metals, Design of Jigs for Single-purpose Machines and Progressive Machinery. Good salary to right man. When applying state salary required, indicating size of previous similar jobs held.—Address, 4763, The Engineer Office. 4763 A

WANTED, Competent STEEL WORKS DRAUGHTSMAN for large works in Sheffield District. State age, experience, and salary required.—Address, P2821, The Engineer Office. P2821 A

WANTED, DRAUGHTSMAN (25-30), Accustomed to general arrangement and lay-out drawings for Mill and Factory Buildings. Experience with Paper Mill Plant desirable, but not essential.—Address, P2823, The Engineer Office. P2323 A

WANTED IMMEDIATELY, FOUR First-class MECHANICAL DRAUGHTSMEN, with full experience of Hydraulic Pump and General Steam Engine Work.—Apply by letter, stating age, experience, and salary required, to HATHORN, DAVEY and CO., Ltd., Sun Foundry, Leeds. 4746 A

WANTED, JUNIOR DRAUGHTSMEN for Crane and Conveyor Work in large works in Leicestershire.—Address, stating age, qualifications, when at liberty, and salary desired, to 4719, The Engineer Office. 4719 A

A JUNIOR DRAUGHTSMAN REQUIRED, who has had experience in Oil Engine Construction and Manufacture.—Write, stating age, experience, references, and salary required, to Box No. 896, Advertising Offices, 84, Queen Victoria-street, London, E.C.4. 4759 A

CHIEF DRAUGHTSMAN, Having a Thorough Locomotive and Electrical experience, with practical and theoretical knowledge of the Internal Combustion Engine.—Apply, giving full particulars and testimonials (copies only), to NORTH BRITISH LOCOMOTIVE CO., Ltd., 110, Flemington-street, Springburn, Glasgow. P2315 A

DRAUGHTSMAN WANTED for London District; previous experience in preparing Shop Details for Structural Steel Work essential.—Address, giving age, particulars of experience, and salary required, 4789, The Engineer Office. 4789 A

DRAUGHTSMAN, Well Accustomed to Steel-framed Buildings, able to design to L.C.C. by-laws, to take out quantities for estimating and ordering materials and make all detail working drawings. State age, wages required, and when disengaged.—Address, 4787, The Engineer Office. 4787 A

DRAUGHTSMAN WANTED for London, Experienced Cement Machinery, accustomed Design Elevator, Conveying Plant, Rotary Kilns, Crusher and Disintegrating Machinery. Please send full particulars age, experience, salary required.—Address, 4794, The Engineer Office. 4794 A

DRAUGHTSMAN WANTED, London, Accustomed to design, detailing Elevators and Conveyors, preferably with experience Disintegrating and Grinding Machinery. Please send full particulars, age, experience, salary required.—Address, P2816, The Engineer Office. P2816 A

SITUATIONS OPEN (continued)

FULLY QUALIFIED DRAUGHTSMEN WANTED, thoroughly conversant with modern Commercial Vehicle Design. Several years' experience in the trade essential (London district).—Address, with full particulars, 4755, The Engineer Office. 4755 A

GOOD DETAILING DRAUGHTSMAN WANTED for London office. One thoroughly conversant with Steel-framed (1909) Work. Early start wanted.—Address, stating age, experience, and salary expected, also when free for engagement, P2793, The Engineer Office. P2793 A

HEAD ENGINE DRAUGHTSMAN and DESIGNER WANTED by Marine Engineers in Shanghai, to Take Charge. Must have knowledge of repairs; 3 years' engagement at £45, rising to £50, per month. Passage paid out and home.—Address, stating age, detailing experience, with copies of testimonials, P2327, The Engineer Office. P2827 A

JUNIOR DRAUGHTSMAN for South Wales. Practical man used to Conveyors, Structures and General Work. State age, experience, references, and salary expected.—Address, P2788, The Engineer Office. P2788 A

SENIOR LOCOMOTIVE DRAUGHTSMAN REQUIRED for large Engineering Works, North of Spain. Knowledge modern shop practice essential. Single preferred, age 30 to 40.—Address, 4795, The Engineer Office. 4795 A

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BREAKDOWN CRANES.

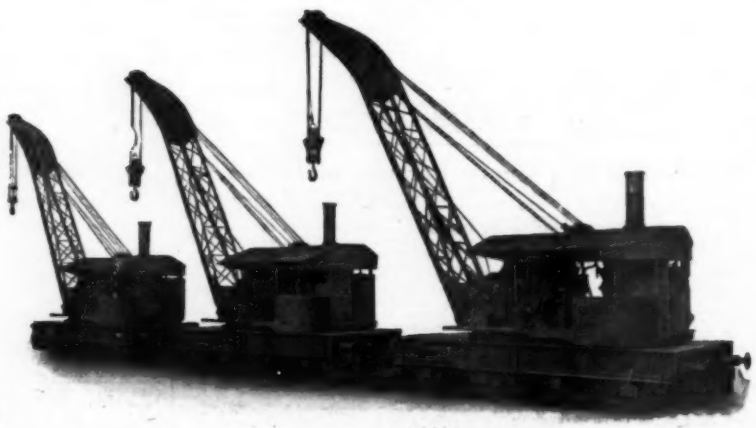


FIG. 1157.

THREE 25-TON CRANES FOR ARGENTINA.

STOTHERT & PITT, LTD., BATH, ENG.

A Seven-Day Journal

Rivers Pollution.

ON Tuesday last a deputation composed of a Joint Committee of the British Waterworks Association and the Salmon and Trout Association—the latter supported by other bodies—presented to the Government a proposal having with its object the reduction of pollution of rivers. It was submitted that, under present conditions, there was a lack of co-ordination amongst the various authorities concerned with different aspects of rivers, and that even different departments of one body—for example, the Ministry of Agriculture and Fisheries—might and actually did recommend courses that were antagonistic. The situation was, it was admitted, difficult, but the fault lay with the present system—or lack of it—and not so much with the authorities concerned. The proposal was made that a central authority taking the form of a Permanent Commission or Committee, giving representation to all interests involved, should be appointed. The pressing need was for a tribunal that would consider all river problems from a national and not a departmental point of view, and it was therefore urged that for the proposed authority to be definitely attached to any one of the existing Government Departments would be fatal. It was suggested that the proposed authority should act directly under the Privy Council. With regard to the powers to be conferred on the authority, it was realised that that would be entirely a matter for the Government, and it was fully understood that pollution would be only one of the problems dealt with. A necessary complement to the appointment of a central authority would probably be the setting up of Rivers or Watershed Boards for all the rivers of England and Wales.

Naval Armaments.

THE message from President Coolidge proposing a conference to consider an extension of the Washington Agreement for the limitation of naval armaments to the lighter classes of vessels, such as cruisers and submarines, has met with a reception in France which leaves no doubt as to its ultimate fate. Having started upon the reconstruction of their navy under conditions which afford them a justifiable pride in the results, the French object to any attempt to interfere with the completion of their work, unless something is done at the same time to render that work unnecessary. They are prepared to examine any proposal for a further limitation of naval armaments on condition that military armaments are restricted in such a way that aggression will become impossible. This is the line they have taken up at Geneva. Until this result is secured an efficient navy is regarded as indispensable for the defence of the second greatest colonial Empire, and for the time being it will be difficult to induce the French to accept any limitation of light surface vessels and aircraft which are necessary to ensure communication between France and the African colonies.

A Proposed Three-shift Day.

THE Clyde Shipbuilders' Association has now under consideration, we understand, proposals for the introduction of a three-shift day, which have been prepared by the Clyde district officials of the United Society of Boilermakers and Iron and Steel Shipbuilders. It is suggested that as there is a considerable amount of work on hand means should be found to employ an increased number of men by carrying on the work continuously. The three shifts which have been proposed are from 6 a.m. to 2 p.m. the first shift, 2 p.m. to 10 p.m. the second shift, and 10 p.m. till 6 a.m. the third shift. Such an arrangement of hours would, it is argued, allow, apart from mealtimes, work to be carried on continuously. It is further claimed that such a system would permit of the employment at an early date of a large number of men now idle, while it would almost wholly do away with the necessity for working overtime. At present the matter has only been brought up by the Boilermakers' Society, but if such an experiment be thought to be advisable it will have to be laid before all the shipyard unions. We believe that a three-shift day was worked on the Clyde during the war period. Whether, however, such a procedure can now be usefully adopted will require very careful consideration. A fair number of shipbuilding orders are at present in hand, but so far the increase in employment has been necessarily slow, largely owing to the as yet restricted supplies of material.

Shipbuilding and Trade Guarantees.

THE guarantees granted by the Treasury under the Trade Facilities Act amounted, up to the end of last year, to a total of £70,721,780. Particulars which were recently published concerning the latest grants, totalling over £3,000,000, show shipbuilding to be largely represented. The Ocean Steam Navigation Company, Limited, is to receive a guarantee of £900,000 for the construction of a vessel at Belfast; Frederick Leyland and Co., Ltd., £180,000 for a ship to be built at Dundee; the Hopemount Shipping Company, Ltd., an additional £81,000 for a Clyde-built ship; and the Tank Ship Construction Company, Ltd., £65,000 for the construction of a tanker at Jarrow-upon-Tyne. Further guarantees covering the erection and equipment of works and extensions to plant include £180,000 for the Steel Company of Scotland, Ltd.; £225,000 for the Lincolnshire Beet Sugar Company, Ltd., for a new factory at Bardney; and an additional £25,000 for Eastwood's Cement, Ltd. Guarantees dealing with electrical machinery and equipment comprise one of £20,000 for the Rossshire Electricity Supply Company, Ltd., for extension of supply; and an additional £150,000 for the Anglo-Japanese Development Company, Ltd., for the purchase of rails and electrical equipment in Great Britain. Finally a guarantee of £1,200,000 has been granted to the Hungarian Electrical Scheme for electrical equipment to be purchased in this country.

The Eight Hours' Day in France.

WHILE the French Senate has passed the Bill in accordance with the Washington Convention limiting the number of working hours to eight a day, the vote was conditional on the same limitation being adopted in Great Britain and Germany. The voting of the Bill was mainly a concession to principle, and on its return to the Chamber of Deputies it is likely to undergo considerable changes, even if some pretext is not found for further postponement. Under present conditions there is a strong feeling in France against any hard-and-fast limitation, on the ground that the only hope for the future lies in increased production and lower costs, and, moreover, the legislation must be adapted to the requirements of different industries. The existing French legislation, while recognising the eight hours' working day, is of an elastic character and contains all kinds of exceptions, the most important of which is the right of employers to require the men to make good the time lost on holidays and other occasions, although this excess time must not exceed a hundred hours a year. As a matter of fact there is no strict observance of the law in cases where the men are paid by the hour and are usually prepared to work as long as is necessary. It is pointed out that in Germany the eight hours' law is still more loosely observed, to the extent that every employer is able to require the men to work nine hours, and it is possible even to obtain exemption altogether. The French consider that under present economic conditions they cannot afford to be bound down to an eight hours' working day unless it means eight hours of effective work, which is the least that can be permitted if normal production is to be ensured.

The Chamber of Shipping.

THE Chamber of Shipping of the United Kingdom held yesterday, Thursday, February 17th, its fiftieth annual meeting, which this year was preceded on the preceding evening by a jubilee banquet. In his presidential address the Hon. Alexander Shaw made reference to the work of the Chamber and its aims. In its fifty years of service for the industry, the Chamber of Shipping had sought, he said, to secure a fair chance for British shipping throughout the world. While pursuing this aim it had been unremitting, he thought, in its diligence in foreseeing and in warding off attacks which had menaced shipping interests both at home and abroad. The Chamber had also been effective in cultivating good relations between those concerned in shipping matters in all the principal countries of the world. That there were difficulties around and ahead of us he did not doubt, but with the recollections of the work of the past half century and the spirit in which it had been done, we could face and overcome them. The annual report of the Chamber deals fully with the economic position of shipping and is replete with statistical information. At the meeting above referred to resolutions were passed on the subject of Government interference with industry and shipping, recommending that any such interference should be reduced to a minimum and that the control of all matters affecting sea transit should be concentrated in a single department. The Chamber also welcomed the proposal for a World Economic Conference to study the removal of trade barriers as a practical step towards the solution of outstanding industrial and commercial problems.

British Shipping and the Coal Dispute.

THE annual report of the Liverpool Steamship Owners' Association, a body the members of which own more than a quarter of the total British steam tonnage afloat, should serve definitely to remove the impression still held in some quarters that the recent trouble in the coal industry benefited shipowners by providing them with the unusual task of bringing large quantities of coal to this country. That traffic was advantageous only to a small proportion of the industry, and the benefits conferred were, it is stated in the report, trivial in comparison with the losses sustained by the industry as a whole, particularly by the liner side of the business. Running costs were substantially increased without compensating increases in the earnings. There was, too, a great wastage of carrying power. On outward voyages ships sailed partially light through lack of cargo, and on the homeward voyages space which might have been used for cargo had to be devoted to bunkers as a result of the necessity of bunkering abroad for the round voyage. Compared with 1925, this country last year exported 32 million tons less coal. Compared with 1913 the decrease amounted to 55 million tons. This second figure represents the equivalent of more than 10,000 outward voyages from this country by ships in ballast. The loss represented by this wasted space was a heavy burden on both outward and homeward voyages. It was only partially made good by the importation of 21 million tons of coal, of which the bulk, but not the whole, was carried in British bottoms.

Serious Railway Collision at Hull.

ON Monday morning last, the 14th instant, as the train from Withernsea, due at Hull, Paragon Station, at 8.56, was passing under Argyle-street bridge, which is about 800 yards from the station, it met, head on, the train for Scarborough that was due out of Hull at 9.5. Judging by the photographs of the two engines concerned after the collision, the impact could not have been very severe. It was, however, sufficient to cause some telescoping of coaches in both trains, and thereby ten passengers were killed. At the time of writing the cause of the disaster has not publicly been made known. The meeting of two trains in this way could only occur as a consequence of an irregularity. There are at least three possible causes: the driver of one of the trains might have passed a signal at "danger;" the signalman might have prematurely replaced his signal and thus permitted himself to change irregularly the road in front of one train; the signalling might have been out of order. In due time the cause will be revealed at either the coroner's inquest or the Ministry of Transport inquiry.

The Late Dr. Erskine-Murray.

DR. JAMES ROBERT ERSKINE-MURRAY, who was a well-known authority on wireless matters, died at Portsmouth on Saturday last, February 12th. He was born in Edinburgh on October 24th, 1868, and was the eldest son of Mr. Alexander Erskine-Murray. After studying under Lord Kelvin at Glasgow University for a period of six years, he entered Trinity College, Cambridge, as a research student. For two years, namely, 1896–1898, he was Assistant Professor of Physics and Electrical Engineering at the Heriot-Watt College, and subsequently he was appointed experimental assistant to Mr. Marconi. In 1900 he became lecturer and demonstrator in physics and electrical engineering at University College, Nottingham, and in 1905 he took up a similar position at the George Coats Technical College, Paisley. Subsequently he was occupied in consulting work, and from 1907–1911 he was lecturer on radio telegraphy at the Northampton Institute, Clerkenwell. In 1913 he became a partner in the firm of Clark Forde, Taylor and Erskine-Murray, consulting engineers. During the war he served with the Royal Air Force and was in charge of the design of wireless instruments and experimental work. Afterwards he was appointed Experimental Engineer at H.M. Signal School, Portsmouth. He was the author of several books on wireless telegraphy, a fellow of the Royal Society of Edinburgh, of the Institute of Physics, and of the Institute of Radio Engineers. He was also a past-president of the Wireless Society of London.

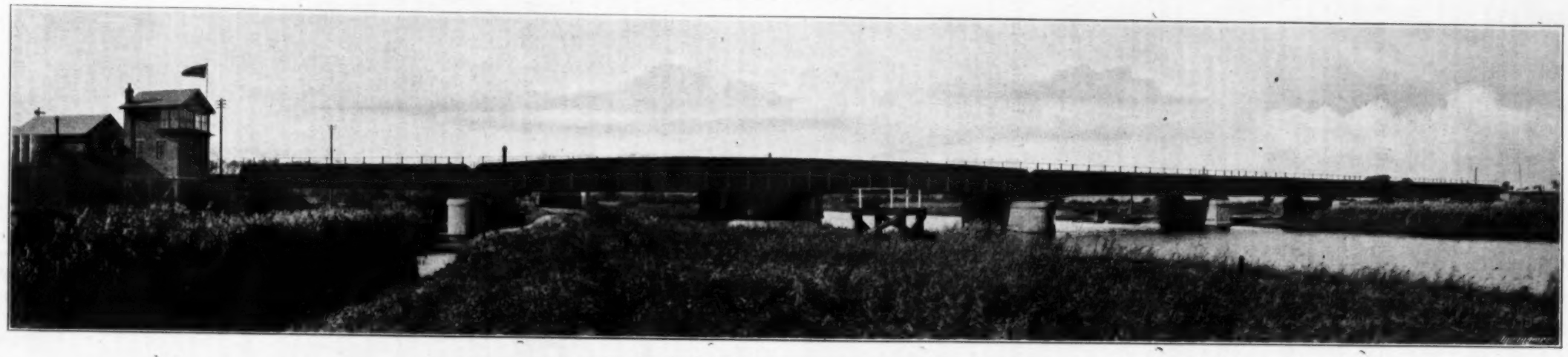
Landing Aeroplanes in Foggy Weather.

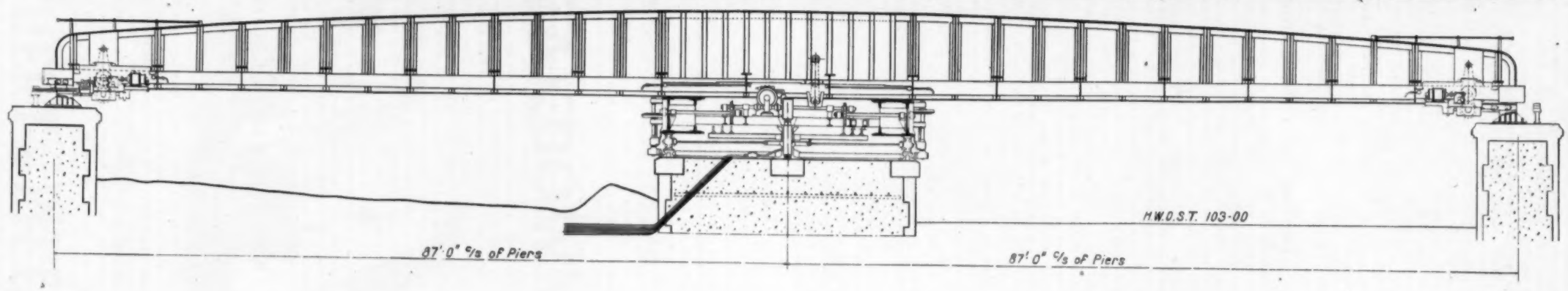
FOGGY or cloudy weather has nowadays little effect on the flight of aeroplanes from one terminus to another, for once in the air the machines with modern aids to navigation are no longer dependent, as was once the case, upon the sight of land for the setting of their course. It delays or interrupts the air service almost entirely, because of the difficult landing conditions which it imposes. Neon tubes give a particularly penetrating light, but experiments made at Croydon suggest that by themselves they are not sufficient to ensure safe landings in fog. Their effect in penetrating the fog seems to be variable in a peculiar way. The actual tubes themselves can be seen through a layer of fog 300ft. deep when the observer is some height above the belt. Coming lower the tubes disappear, but a red pool of light appears on the fog surface. At a still lower altitude the red glow disappears, but at 150ft., while in the fog itself, the observer again sees the lights. A leader cable in conjunction with neon lights seems to promise a satisfactory solution of the problem, and if experiments now being made by the Royal Aircraft establishment in the Woking-Basingstoke area are successful; practical developments in this direction may shortly be expected. The experimental leader cable consists of a length of five miles laid in the form of a very elongated oval. The oval form has been adopted in preference to a straight cable, because with the latter there is considerable technical difficulty in arranging for the return of the current without disturbing the regularity of the field. Two search coils are carried on the wings of the aeroplane, and are connected to an instrument in the cockpit, which by means of lights tells the pilot whether he is to port or starboard of the cable, and also indicates to him his height above it.

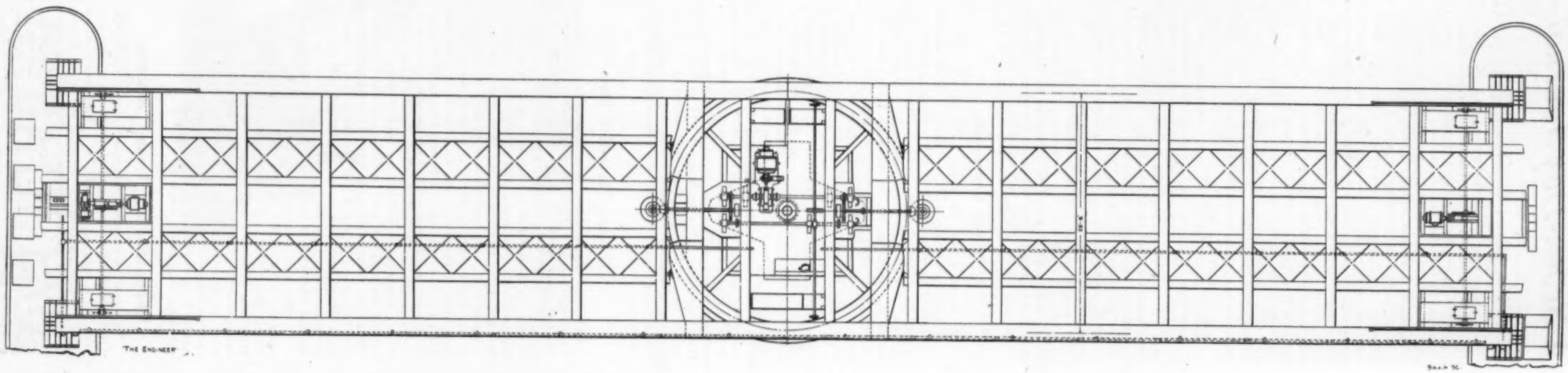
SWING BRIDGE OVER THE RIVER WAVENEY AT BECCLES—L. AND N.E. RAILWAY

MR. JOHN MILLER, M. INST. C.E., AND MR. C. J. BROWN, M. INST. C.E., LONDON, ENGINEERS

(*For description see opposite page*)







Swing Bridges at Beccles and St. Olave's.

THE bridges described in this article carry the London and North-Eastern line to Yarmouth over the river Waveney, at Beccles and St. Olave's respectively, where it forms the county boundary between Norfolk and Suffolk.

The old bridge at Beccles consisted of two 35ft. swing spans having a wrought and cast iron superstructure, the centre pivot being supported, in the river, on a cast iron cylinder, 16ft. in diameter, carried on timber piles. On each side of the swing spans was a series of timber openings of about 16ft. span, the overall length of the bridge being about 200 yards.

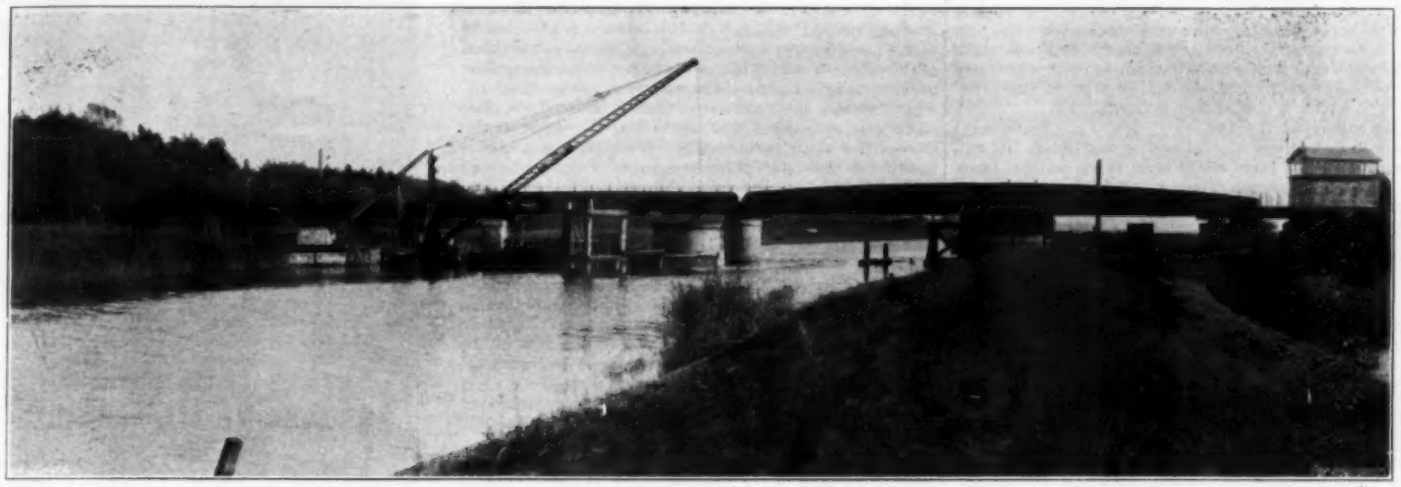


FIG. 1—SWING BRIDGE OVER THE RIVER WAVENEY AT ST. OLAVE'S

At St. Olave's, the old bridge was of a similar character, the two swing spans over the river being each 44ft. 3in., and the approaches on each side were of timber construction. In both cases the bridges were worked by hand gearing.

Prior to the reconstruction, the railway was only single line over the swing spans and approaches, continuing as a double line of way at each end, traffic being worked over the single line by a pilotman, who also operated the opening and closing of the bridges for river traffic when necessary. The bridges were originally constructed about seventy years ago, and were strengthened in the years 1900 and 1903. In reconstructing them it was decided to provide for a double line and do away with the single line working. Parliamentary Powers were obtained in the year 1912 to construct a double line of railway, and to deviate the line at both places; for a length of about 850 yards at Beccles and 550 yards at St. Olave's.

Originally, two signal boxes were provided at each bridge; one of them has now been dispensed with in each case, and the deviations of the line enabled the reconstruction to be carried out with a minimum of interference with the existing bridges and the railway and river traffic. Owing to the war the work was suspended, but in 1924 contracts were let for both bridges and construction was begun.

General Description.—The bridge at Beccles—see the half-tone engraving on page 176—consists of two swing spans of 47ft. 5in., the pivot pier being situated on the South Bank of the river. On the South side there is an approach span 58ft in width, and on the North side four approach spans, one of 58ft. 6in. across the Northern side of the river and three of about 55ft. span on the land. The clear headway under the fixed river spans and the swing span, when closed, is 9ft. 8in. above high water, the difference of level between high and low water being 2ft. 9in. The overall length of the bridge between the faces of the North and South abutments is 446ft. 6in.

The bridge at St. Olave's—see Fig. 1—is similar in design, the two swing spans being each 66ft. 2in. A south approach span of 25ft. and six approach spans on the North side, one of 65ft. over the river and five land spans of 45ft. 6in. The clear headway above high water is, in this case, 14ft. 6in., and the range of tide 3ft., and the overall length between North and South abutments is 530ft. 6in.

In each bridge the three piers carrying the centre pivot and the two ends of the swing spans are constructed of concrete hearting with brindle brick facing. These piers are founded on steel caissons filled with concrete, which were carried down to a depth of 33ft. below low water at Beccles and 60ft. below low water at St. Olave's, the foundations being green sand, gravel and coarse ballast in the former and green sand in the latter case. The material passed through in sinking the centre pier at Beccles was peaty soil for a depth of 25ft., followed by sandy silt, chalk and stones, and at St. Olave's 52ft. of marsh ooze or estuarial mud. The piers and abutments for the approach spans are of solid brickwork built on concrete foundations carried on reinforced concrete piles, the specified set for the last blows on these being ¼in. from a 2½-ton monkey falling through 3ft., the actual set obtained being about $\frac{1}{16}$in.

The total weight of steel work in the Beccles bridge is 1230 tons, the swing span weighing 390 tons and the caissons 342. In the St. Olave's bridge the total weight of steel work is 1266 tons. The bridges are designed to carry a live load equal to eighteen times the British Standard unit loading, and the material is stressed and designed in accordance with the British Standard Specification.

In both bridges the swing spans are worked electrically by motors carried on the swing span itself, the power being transmitted through spur gearing to the operating pinions, which engage in fixed circular racks attached to the pivot piers. These racks are complete circles, it being the original intention to turn the span through 360 deg. to obviate wear, but owing to the difficulties of obtaining correct alignment, it is only operated through an angle of 90 deg. Hand gear is also provided for operating the bridge, in case of failure of electric current or repairs to the electrical machinery being necessary. Timber dolphins are erected in the river at each end of the swing span in the open position for the protection of the river traffic.

Under-water Foundations.—The caissons on which the swing span piers are founded were sunk below the bed of the river under compressed air, the maximum air pressure recorded at any time during sinking being 31 lb. per square inch above atmosphere at St. Olave's, where the depth is 60ft. below low water level. These caissons are circular, having a diameter of 30ft. 10in. over the cutting edge, and are built of steel plates ½in. in thickness; the permanent caisson under the centre pier at St. Olave's is 51ft. in height. Beyond the permanent work temporary strakes were bolted on as the exigencies of sinking required, and were disconnected and removed after the permanent caissons had reached the final depth. The height of the working chamber was in all cases 7ft. 6in. above the cutting edge. No serious difficulty was encountered in sinking the caissons.

Superstructure.—The swing spans are of similar design in both bridges and consist of two main girders, 136ft. and 173ft. 8in. overall length at Beccles and St. Olave's respectively, spaced at 28ft. 6in. centres. They are of steel plate construction with curved top booms. The web stiffeners are of heavy angles with curved hanging plates for the attachment of the cross girders. The cross girders are built up steel plate girders, averaging 10ft. apart, and the rail bearers consist of rolled steel joists, 20in. by 6in. by 65 lb., with a 12in. by ½in. plate on the top flange. Between the rails dished steel floor plates, ¼in. thick, are provided; otherwise the deck is open, with timber walking gangways. The rails are carried on 12in. by 6in. cross sleepers supported on the rail bearers, to which they are securely attached by clips and bolts, the ends of the sleepers being connected together in a longitudinal direction by a 6in. by 6in. timber notched over each sleeper. Each rail is checked over the entire length of the bridges.

The remaining spans of the bridges are, in the case of the Beccles Bridge, all of the main girder, cross girder and rail bearer type, and at St. Olave's, with the exception of the fixed river span which is of the same type, all other spans are of the deck type, with footway brackets on both sides of each span to carry the

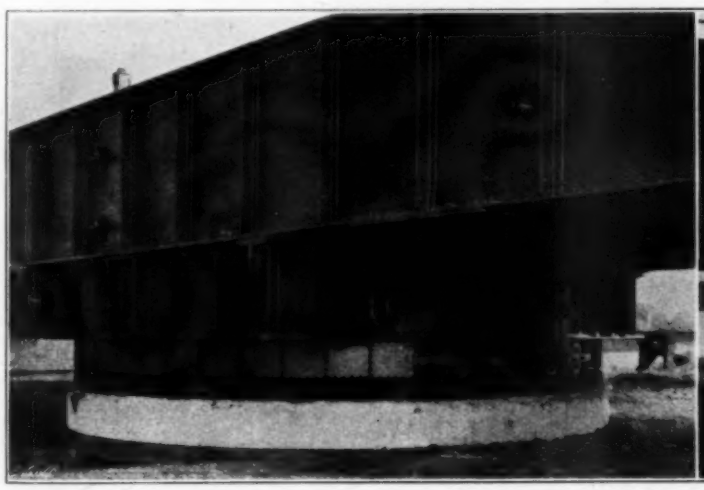


FIG. 2—CENTRE PIER SHOWING TURNING GEAR AND ROLLERS

FIG. 3—CAST IRON BEARINGS, WEDGE GEAR AND BUFFER

timber walking gangways. Throughout both bridges the permanent way is carried on cross sleepers as described above, no ballast being used. The erection of the various spans was carried out by launching out the girders with the aid of a movable trestle in the case of the land spans, but in the case of the swing spans and the fixed river spans pile staging was necessary. The main girders of the swing spans were erected in three lengths. In erecting the swing spans temporary possession of the waterway at each bridge for a period was necessary.

Bridge Turning Gear.—The main girders of the swing spans are attached to and carried on a circular steel plate girder, 28ft. 6in. diameter and 4ft. 3in. in depth, stiffened with two heavy-bearing girders 22ft. apart across the circular girder and projecting therefrom and also attached to the bottom flanges of the main girders. To the underside of the circular bearing girder, the upper roller path of cast steel, averaging 2¼in. thick, machined top and bottom, is bolted. The bottom roller path, also of cast steel, machined top and bottom, is mounted on a heavy cast iron ring with projecting lugs on the bottom to fit into recesses in the granite coping fixed on the tops of the pivot piers, to which it is also bolted down.

The rollers of the live ring—see Fig. 2—twenty-nine in number, are conical and of cast steel, 1ft. 8in. mean diameter, 10in. wide, each fitted with a brass bush and lubricator. They are held in position by radial rods, 1¾in. diameter, with turned ends to suit the brass bushes in the rollers. The rods are attached to a centre spider—which rotates about the hollow steel centre pin—12in. external diameter and 5in.

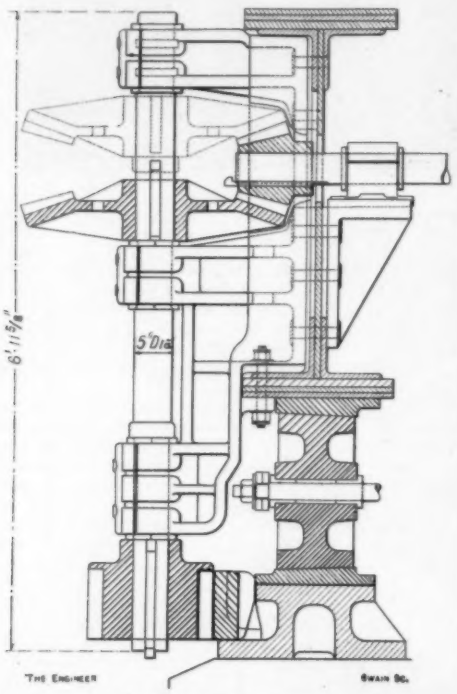


FIG. 4—SWING BRIDGE TURNING GEAR

internal diameter. The pin is made hollow to admit the cables from the power house to the motors on the bridge.

The steel centre pin has a 10in. square neck at the base which rests in a cast iron pedestal bolted to a granite bedstone on the pivot pier. The upper end of the centre pin rests in a casting bolted to the steel framing, which, in turn, is attached to the circular girder. Connecting bars are carried on the projecting ends of the radial arms on the outside of the rollers.

A cast iron circular rack, 28ft. 6in. in diameter, in twenty-four segments, with machine moulded teeth—see Fig. 2—is bolted to the cast iron base ring. Figs. 4 and 6 show a portion of this ring, and one of the main pinions, of which there are two, on opposite sides of the circular rack. These pinions are of cast steel and gear into the rack. The pinions are carried on a vertical shaft, 5in. in diameter, mounted on cast steel brackets attached to the circular-bearing girders. A cast steel bevel wheel is keyed to the top of the vertical shaft and is driven by a steel pinion on the end of the main shaft, 4in. in diameter, mounted in self-oiling bearings. The main shaft is driven by the 30 horse-power motor through a combined worm and spur reduction gear—seen in the drawing on page 176. The main brake operates on the motor shaft and is brought into operation by means of the brake solenoid, which is controlled by a brake relay.

The motor main shaft and reducing gear are housed on a platform supported from the two bearing girders, which cross the circular carrying girder, the bridge floor above completely covering them in. The hand gear, provided for slewing the bridge in case of a mishap to the motor, is operated from the deck of the bridge at the sides of the main girders, through gearing to the main shaft, as indicated in the drawing.

Bearings and Wedges.—The four ends of the swing span girders rest on bed-plates and wedges. The bed-plates are iron castings with a base of 5ft. 6in. by 4ft. 2in., average depth 1ft. 2in., each securely bolted to the piers by four 1¼in. diameter bolts. The top surface of the casting is machined to receive the wedges, and has an inclination of 1 in 6 to the horizontal. Tapered ribs are provided on each side of the bearing surface to guide the wedges. The wedges are of cast steel, 2ft. long, 1ft. 6in wide, depth 9in. to 13in., with an inclination of 1 in 6 on the bottom surface.

The castings are hollow with two internal stiffening ribs. The wedges work in cast steel slides bolted to the bottom flange of the main girders, phosphor bronze wearing plates being fitted to the top and bottom sliding surfaces. In addition, there are fitted to the steel slides adjustable gun-metal bearing strips for lateral adjustment. The wedges are operated in the direction of the main girders by means of screw gearing driven through bevel wheels from the 7½ brake horse-power motor shaft, one motor at each end of the bridge working the two wedges at that end. The gearing and the motor are carried from the bridge floor. Fig. 3 shows the position of one of the wedges, bed-plate and operating gear, as well as the shaft on the side of the main girder for operating the wedge hand gear from the deck of the bridge.

Locking Bolts.—One turned steel locking bolt, 4in. external diameter with tapered end, is provided at each bridge. The bolt works in a slide attached to the underside of the bridge floor, and is operated by a screw working inside the bolt, driven through gearing from a 1½ horse-power motor attached to the bridge. It enters a cast steel housing bolted to the top of the pier. Limit switches are operated by the bolt and give the necessary locking in the signal cabin. The drawing on page 176 shows the position of the bolt.

Buffer Stops.—A spring buffer stop is mounted on the pier at the locking bolt end of the bridge alongside the wedge bed-plate—see Fig. 3.

New Signal Boxes.—A new signal box has been erected at each of the bridges, from which the movements of the bridges, in addition to the signalling of the railway, are operated by the signalman. These boxes are carried on reinforced concrete piles, and, as already pointed out, each takes the place of two boxes required prior to the reconstruction of the bridges.

Power Equipment.—There being no supply of electric power available in the neighbourhood of either bridge, it has been necessary, at each place, to put down a special plant for the generation of electrical energy. The power houses—see Fig. 1 and the half-tone engraving on page 176—are brick buildings supported on concrete piles 53ft. and 59ft. long and 17ft. 6in. wide, with the floor approximately at rail level, and supported on reinforced concrete piles. They contain the batteries, engine and generator, and the main switchboard. The batteries at each bridge consist of 120 accumulator cells having a total capacity of 936 ampère-hours and 1248 ampère-hours respectively at Beccles and St. Olave's. They are capable of opening and closing the bridges forty times per day for seven days after one complete charge of 6½ and 8 hours' duration respectively from the 50-kilowatt set. The plates of the batteries at the two bridges are interchangeable. The engine and generator, which are similar at both places, consist of one double cylinder two-cycle vertical crude oil engine of 94 horse-power, and one 50-kilowatt, 330-volt direct-current generator. The motor switchgear, contactor gear, current collector and cables are also similar for the two bridges.

One 30 brake horse-power 220-volt direct-current motor, running at 550 revolutions per minute, is provided at each bridge for turning the bridges, and is mounted on the bridges over the centre pier. Two 7½ brake horse-power, 220-volt, direct-current motors, running at 530 revolutions per minute, are provided, one at each end of the swing spans for operating the four wedges, which can be withdrawn or closed in 45 seconds. These are also mounted on the bridge. One 1½ brake horse-power, 220-volt direct-current motor is provided at the end of the swing span for operating the locking bolt, mounted in a position adjacent to the wedge motor. The cables pass from the power house and signal-box to the centre pier, and the power is then distributed by means of a 26-ring type current collector, mounted over the centre pin, to the motors and lights on the bridge. The time occupied in the complete operation of opening or closing the bridges is about 150 seconds. Fig. 5 shows the bridge at Beccles in a swinging position.

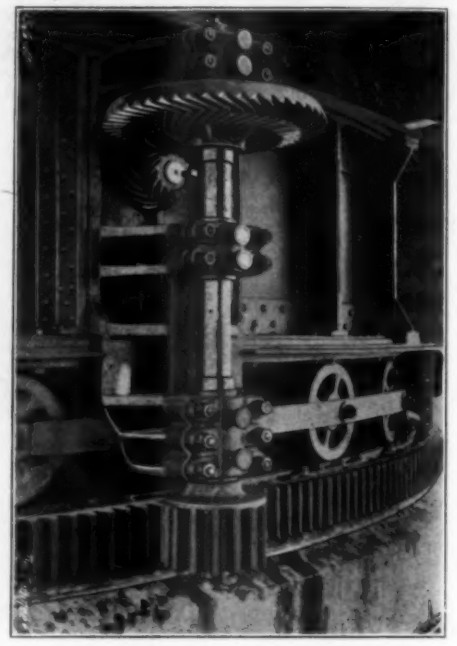


FIG. 6—BECCLES BRIDGE TURNING GEAR

FIG. 5—THE BRIDGE AT BECCLES BEING SWUNG

Contracts for both bridges were let to the Horseley Bridge and Engineering Company, Ltd., Tipton, Staffordshire, the sub-contractors for the sub-structure work being Mitchell Bros., Sons and Co., Ltd., Victoria-street, and for the electric controls the Igranic Electric Company, of Bedford. Work was begun in 1924, and the completed bridges were opened to railway traffic in July and September last at Beccles and St. Olave's respectively. They were built to the design of Mr. John Miller, M. Inst. C.E., formerly chief civil engineer of the Great Eastern Railway, and the work was started under his direction, and completed under the direction of Mr. C. J. Brown, M. Inst. C.E., engineer of the Southern Area of the London and North-Eastern Railway.

Skin Friction Resistance.

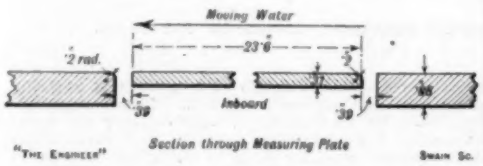
By G. S. BAKER.

THE report issued by the Schiffbautechnische Gesellschaft on "Recent Results of Research Work in Naval Construction," carried out at the Hamburg Experiment Tank, under Dr. Eng. Gunther Kempf, draws attention to one of the outstanding difficulties in connection with tank work, viz., the correct estimation of the frictional resistance of the full-sized ship. This problem is, of course, only a part of the general one of estimating the power required to drive the ship at a given speed, and it is worthy of note in passing that the Superintendents of the Teddington, Washington and Hamburg tanks, have all been working at the comparison of model and ship results, and that each issued a report or paper on this subject during the past year.

In 1924 the Institution of Naval Architects appointed a committee to formulate proposals for the extension of the known data on frictional resistance, and the report of that Committee was issued in March, 1925. The majority of the Committee was of the opinion that the towing of a destroyer hull would give the additional data required. There was an alternative, and tentative proposal that something might be done with thrust meters on propeller shafts. The former of these proposals was ultimately allowed to stand over, mainly on the score of expense, but partly because the difficulties to be overcome were rather serious. The latter method, viz., determination of the resistance from the thrust required to propel the vessel, is being tested by the staff of the National Tank, who are at present engaged on the attempt to do it with a destroyer. That type of ship lends itself to the work, as the interaction between the propeller and hull is comparatively small, and the correction for this term can therefore be applied with some accuracy.

A third method has been evolved by Dr. Kempf, and tested by him on the Hamburg, of the Hamburg-America Line. In brief, the method consists in freeing a small portion of the ship's outer bottom plating, and measuring the frictional force on this piece of plate when the ship is under way. The plates used were square, 23·6in. along the edge, with rounded corners, and were given 0·39in. clearance all round, the bottom plating in the locality being 0·86in. thick. A small tank was built around the opening, inside the hull, the test plate being supported by a buoyancy chamber on its back, and held in position by five pin-jointed rods. The water frictional force was balanced by weights, and the pull of a spring on a bell-crank lever.

Three of these plates were fitted, but one was discarded by the operators owing to mechanical trouble. The two useful plates were 283ft. and 336ft. from the bow, on the parallel-sided amidship portion of the hull—the vessel being 600ft. in length—some 13ft. below the load water line. As there was some doubt as to the effect of the shape of the cross section of the edge of the test plate, which was shaped as in the figure, the resistance of one plate was measured



with its fore edge projecting beyond its true position and was found fairly constant, provided the projection was less than 2 mm. The main difficulty which seems to have been experienced was the mechanical friction, which was relatively high, amounting to a little over 3000 grammes, the measured force varying from 2800 to 2900 grammes. To overcome this difficulty, measurements were made of the forces required to move the plate from aft forward, and from forward aft, and the mean value was taken as a measure of the frictional force.

Although some objection might be taken to the results on the score of this relatively high friction, the method should give a fair approximation to the skin friction of this particular plate, sufficiently accurate to tell where it falls amongst the curves used by naval architects for framing power estimates.

Both plates gave approximately the same result, and the various observations published agree within 3·5 per cent. of each other. For a speed of 16·2 knots the average frictional resistance was 2870 grammes on a wetted surface area of 3·82 square feet. This gives a frictional resistance of 1·66 lb. per square foot. The estimated resistance of 1 square foot of surface, 300ft. from the fore end of that surface, including lap and butt effect, obtained from the curve given in the paper "Notes on Model Experiments"—"Trans.," N.E.C. Inst. of E. and S., 1915—is 1·28 lb. at 16·2 knots. W. Froude's original flat plate results would give about 1·14 lb. for a similarly situated square foot of smooth surface at 16·2 knots. Kempf's long-tube results give a figure in rough agreement with that obtained on the ship. But there is good ground—accepted by Kempf himself—for believing that his tube data gives results higher than would be obtained with iron surfaces of the proportion and shape found on a ship.

In the N.E.C. paper quoted above, a description is given of some experiments in which a band of rough surface was moved to various positions along a hull form. Along the amidship portion of the hull, it had distinctly less resistance than at the fore end, but its frictional value increased towards the stern instead of continually decreasing as it would on a flat plate. In these two cases—two models were tried—the frictional resistance was obviously affected to a quite fair extent by the stream-line flow around the hulls, and this might be the case for isolated spots on the Hamburg.

The possibility of error in the work, owing to the large clearance around the test plates, and to their not being flush with the surrounding surface, was examined by Kempf, and no variation of resistance was found with reasonable movement. This is not conclusive that head resistance was not there, but it makes it very unlikely that any such effect was large. The only other possible source of error was the rather high mechanical friction, which might have lead to error, despite the precautions taken.

When any reasonable allowance for error has been made, it still remains that the resistance measured by Kempf is higher than the estimate made in the usual way. Kempf has attempted to check his result by estimating the total effective horse-power for the ship, accepting the resistance obtained as indicative of the skin friction of the whole ship. The effective power so obtained is 7510 against 6610 by the Froude data. The shaft horse-power for the ship is given as 12,900, and the model quasi-propulsive coefficient as 0·633, and allowing 4 per cent. for shaft and air resistance, he obtains 7840 as the effective power derived from the engine and propellers. This is 5·5 per cent. in excess of Kempf's figure and 15·5 per cent. in excess of the estimate based on Froude's friction data. Although this is not exact, it is most suggestive.

All of this calls to mind the fact that William Froude found the frictional resistance of the Greyhound some 27 per cent. higher than the value estimated from his plank results. The Greyhound had no plate butts and landings, and no rivet heads, but was copper plated. In part, the excess was no doubt due to the bad condition of the copper, but it might equally well have been due to the estimate being wrongly framed. No real satisfaction will be obtained on this matter until such an experiment as was suggested by the Skin Friction Committee has been carried out; and although the difficulties are large, with modern methods and mechanism they can certainly be overcome.

The Steel Cartel.

AT the last meeting of the Steel Cartel in Luxemburg some questions were discussed involving the future of that combination, which would probably come to a speedy end if it were found impossible to provide a satisfactory solution. The whole trouble arises from the changed attitude of German steelmakers, who affirm that they are placed in a very unfair and anomalous situation by the unexpected turn that events have taken during the past two or three months. The Germans originated the idea of the Cartel some years ago in the belief that, in view of the enormous increase in continental steel production, the industry could only be saved from ruinous competition by limiting the output to the needs of consumers. They were particularly afraid of competition from countries like France, where depreciated currencies gave steelmakers an opportunity to monopolise foreign trade. It was only when those countries began to see that their situation was becoming precarious that they hastened to combine for a limitation of output and a stabilisation of prices. So far as France and Germany were concerned, there was also a question of political advantages, which apparently have failed to materialise, and that is one of the reasons for the discontent now prevailing in Germany. In the hope of securing those advantages German steelmakers now affirm that they made greater concessions than could be reasonably expected of them. Of late, two things have happened which raise some doubt whether the Cartel, in present circumstances, is really effective in its operations. The expectation that steel prices would be definitely stabilised by a limitation of production has not been realised, for while prices at first resisted the influence of a declining demand they have since given way, although they would certainly have fallen much lower had the Cartel not been in existence. The other factor in the situation is the heavy demand for steel in Germany. Steelmakers supplied that demand without any consideration for the quota allotted to them, and having largely exceeded their share of the production they find themselves liable for the payment of a considerable fine, represented by four dollars for every ton in excess of their participation, which fine has to be paid to a common fund for partial distribution to those producing countries which have not attained their quota. As a matter of fact, Luxemburg is the only member which can claim an indemnity of two dollars a ton for an under production. German steelmakers regard this as distinctly unfair, since one of the objects of the Cartel was to enable the producers of each country to monopolise their own market, and they now argue that no account should be taken of the quantity of steel supplied to home consumers. They insist that the statutes of the Cartel should be entirely revised. They must either have a much larger quota to enable them to supply the home demand or the Cartel must only apply to foreign trade, in the same way as the Rail Union.

This attitude is strongly resented by French steelmakers, who find themselves in a situation entirely different from that of the Germans. While in Germany the demand for steel is so great that there is nothing left for export, in France the requirements are at present so small that steelmakers have to rely almost entirely on foreign markets, and they object to being deprived of the opportunity of selling steel in Germany, which they are entitled to do on condition that prices are not above those of German firms. Any deficit in Germany would benefit the Lorraine producers and relieve the French market of a considerable burden. This apparently inextricable situation has led to many suggestions being made in Germany for a withdrawal from the Cartel. It is said to have failed in its object, partly because the Cartel was constituted during the period of the miners' strike in Britain, and the organisers failed to take sufficiently into account the possible competition of British steel. As a matter of fact, they were fully aware of this possibility, and were fairly certain that British steelmakers would join the Cartel, and were not far from believing that, in the event of abstention, they would be in a position to force the hands of the British, if necessary. Belgian firms refused for a long while to enter the Cartel unless they were assured of the co-operation of British steelmakers. The failure to secure that co-operation is the principal cause of the weakness that has developed in the organisation. There can be no stability of prices when continental firms find themselves in competition with the British. So long as the consumption in Germany exceeds the quota of steelmakers in that country the Cartel is playing into the hands of British producers.

The object of the recent meeting in Luxemburg was twofold, first to fix upon another reduction of the steel output from April 1st next; and, secondly, to effect some compromise which would save the Cartel from collapse. Notwithstanding the troublous period through which it is now passing, it is quite evident that no one desires the suppression of the Cartel, least of all German steelmakers, if only they can obtain what they regard as reasonable treatment. Even in Germany the situation may change, and steelmakers there may find it necessary to look to foreign markets, when the operation of the Cartel will be of great value to them. The French have everything to gain by supporting this organisation, for its failure at a time when production costs are relatively high as compared with the present value of the franc would place them in an extremely unsatisfactory situation. It would mean a collapse of the steel trade, which would only profit consumers. In these circumstances an effort is being made to give some satisfaction to German steelmakers, and it is suggested that the heavy fine to which they have rendered themselves liable should be remitted and that they should be entitled to produce all the steel required for the home market, on condition that they sell nothing for export. In a word, all the foreign business is to be left in the hands of French, Belgian and Luxemburg producers during a stated period, and when German firms find it necessary to dispose of steel abroad they shall only do it progressively—that is to say, they can only resume their foreign trade in a way that will not jeopardise the interests of other members of the Cartel. It is not yet known how the Germans will accept this proposal. It may not find immediate favour with them, for there are many economic questions bound up with the Cartel, and the Germans will certainly want to settle as many of them as possible before they come to a final agreement. Much has to be done before the next meeting, which is to be held in Berlin, but there is a general impression that the Cartel will pass successfully through the ordeal, for its suppression at the present moment would place the continental steel industry in a hopeless situation.

South African Mining Prospects for 1927.

THE South African mining industry did excellently during 1926 and left all the previous records behind. The total value of the mineral production of the Union for 1926 was 58¼ millions sterling, approximately, as compared with 54¼ millions sterling for 1925. For the increase gold and diamonds were mainly responsible, with increases of approximately 1¼ million sterling and 2½ million sterling respectively. Owing to the British coal strike South African coal had an increase in output value of nearly £200,000, and platinum made its first appearance with an output of over £100,000. Tin and "other minerals" had small increases, while copper showed a reduction, as also did silver and osmiridium.

In 1927 it is quite certain that, provided there are no industrial disturbances or grave accidents, still another record will be established. There were many important achievements in the past year which will have a marked effect upon 1927 and following years. The completion of the East Rand Proprietary Gold Mines—Cinderella negotiations was one of the great events of the year, the amalgamation of those two big properties having been brought about, with the result that Cinderella, with its great virgin area, will now become a producer. The Sub-Nigel Gold Mining Company acquired an area of several thousand claims, which, as they adjoin the company's property, are already being opened up. A tender by the Union Corporation, Ltd., for a lease of an area of 2641 claims, which adjoin the Corporation's Geduld Proprietary Mine, was accepted by the Government, and a new development in the Far East Rand, which would fill a most significant gap in the industry, is indicated. Attention is now being focussed upon the Nigel and Heidelberg areas, where the present year should see important developments, there being three or four big schemes in train. Given a period of peace it is probable that large sums will be forthcoming to open up new mines in the South-East and replace those about to give out on the Central Rand area. Provided capital is given proper encouragement there is good hope that the gold-mining industry can be maintained on much the same scale as at present for years to come.

There are also gratifying signs of progress and improvement in mining methods. The general appreciation and adoption of clean mining and the focussing of attention upon profits, rather than cost per ton, are matters of prime

importance. The continual advance in the rate of breaking rock, brought about by the jackhammer, the hole-director, &c., and close study of their efficient application, are drawing attention to the operations necessary to bring the rock to the mill, and to improve the efficiency of all behind the stoper and developer. New systems of support, the aim of which is to permit the complete extraction of the ore in a block in one operation, thus eliminating the costly work of reclamation, are in use underground, while mechanical methods of delivering the ore from the face to the main tram tracks are receiving careful study. The results of these developments will be to reduce the number of natives required to keep the industry going at full speed, a most important consideration in view of the severe shortage of natives which occurs each year during the ploughing and harvesting seasons.

The other old-established branches of mining—diamonds and coal—had a good year. The production of alluvial diamonds has expanded to relatively huge proportions, and that branch of the industry is causing the big diamond mine-owning companies much alarm, as, in order to prevent losing the control of the market, and so seeing a slump in the price per carat, they have to purchase most of the diamonds produced by the alluvial diggers, and also reduce *pro rata* the production of their own mines. Of course it is impossible even to make a guess of what the diamond demand will be like this year, as fluctuations are so frequent and often extreme. At present the demand is good, especially for large stones, but there are said to be signs that the market is beginning to show a weakening tendency.

Coal, while it has long been doing extremely well, as the result of the British coal strike, would have done much better had it not suffered from truck shortage, which appears to be chronic, but further expansion of the coal production in 1927 seems assured.

In the field of platinum, important progress was made towards the solution of the extraction problem, which will ensure a satisfactory future for the select few undertakings, with material resources in the way of ore and capital, which promise to emerge as steady producers. Though the platinum mining industry is now certainly well founded, and will be one of importance, in view of the relatively small consumption, it cannot expect to attain to proportions comparable with gold and diamond mining, and it will probably be necessary for the companies to arrange to control the output.

The year was noteworthy as far as base metals and minerals were concerned, and one or two really outstanding successes drew general attention to the varied resources of the Union and their economic possibilities. The most spectacular event of the year will, it is thought, prove to have been the arrangements made for exploiting the manganese deposits near Postmesburg. The production of asbestos is increasing continually, and the demand for good crocidolite fibre cannot be nearly met as yet, but extensive plants are being put down and a very large production should result this year. There is a desire, however, to see the finished products manufactured in the Union, and there is more than a possibility that 1927 will see the establishment in the Union of such a manufacturing industry on a big scale. Meanwhile other minerals, such as mica, fluorspar, chromite, corundum, magnesite, and talc are receiving increasing attention, and the outputs of several of these minerals are rapidly increasing, and will certainly bulk in the exports very soon. The demand for chrome ore is particularly keen, and American capital is opening up some important deposits. Altogether it seems safe to say that this year the total value of the metals and minerals produced—including gold and diamonds—will go well over sixty millions sterling.

Work-hardening Properties of Metals.*

By EDWARD G. HERBERT.

(*Concluded from page 157.*)

Work-hardening Changes and the Durability of Cutting Tools.

In a paper presented to the Iron and Steel Institute in 1910 a description was given of a tool steel testing machine which is essentially a vertical lathe with devices for measuring the blunting of the tool as the cut proceeds, and for recording the amount of metal cut from the work piece—a standard steel test tube. The durability of a cutting tool is measured at successive speeds, and a set of speed-durability curves is reproduced in Fig. 35. The characteristic features of these curves are the low durability of the tool at low speeds and its increase at higher speeds, and the occurrence of two peaks or maxima. The first of these characteristics is common to the speed-durability curve of every tool that has been tested on these machines in the course of seventeen years, and the second characteristic, the double peak, is of general, though not universal, occurrence.

Though these curves undoubtedly show the durability of tools cutting under certain standard conditions, it has been felt that some explanation of their principal characteristics was necessary before they could be accepted as representative of the behaviour of tools in general, and there seemed to be only three directions in which this explanation might be sought :—(1) In some obscure changes taking place in the tool as its cutting speed (and temperature) increased ; (2) in some inherent difference between the testing machine and the lathe ; or (3) in some changes taking place in the work piece (the test tube) as the speed and temperature increased.

(1) The changes in durability were, for many years, attributed to some unexplained changes taking place in the tool under the influence of cutting temperature, but a fresh difficulty arose when it was found that the same general form of curve was given by tools of carbon steel, high-speed steel, and stellite. Significant fluctuations were known to occur in the hardness and other properties of tool steel under the influence of temperature, but these fluctuations were not in themselves capable of accounting for the form of the speed curve, and it seemed wholly improbable that similar changes should take place at approximately the same cutting temperatures in metals so dissimilar in composition as tool steel and stellite.

(2) No essential difference was apparent between the vertical lathe known as the tool-steel testing machine and the lathes used by engineers such as would account for the peculiar form of the speed curve, and when in 1914 Denis published a large number of speed-durability curves produced on an ordinary lathe and having all the essential characteristics of the testing-machine curves, including low durability at low speeds and the double peak, it became apparent that this form of curve could not be attributed to anything in the design or construction of the testing machine. P. Denis has recently published an elaborate work giving detailed instructions as to speeds, feeds and cuts for all kinds of engineering operations, and all based on his typical double-peaked durability curves with low durability at low speeds. More recently Dempster Smith has conducted an elaborate investigation on the lathe, and has produced a series of speed-durability curves similar in form to those originally produced on the testing machine. (See Fig. 36.)

(3) That the peculiar form of the speed curve must be attributed to effects of temperature not only on the tool but also on the work material was early recognised, but a review of the known changes in the physical properties of unhardened steels and other metals occurring at various temperatures failed to produce any evidence of changes at low temperatures which could possibly account for the form of the speed curve. Highly significant changes, particularly in the elongation and reduction of area in tensile tests, were known to occur at temperatures as low as 300 deg. Cent.—572 deg. Fah.—but there appeared to be no important changes at lower temperatures.

It was only when temperature-work-hardening tests were made, first on the steel used by Dempster Smith in his lathe tests—Figs. 22 and 36—and later on the Vickers test bar steel used for the test tubes, and later still when Goffey and Thompson's results were brought into review, that light was thrown on the subject. The temperature-work-hardening curve of the test tube steel is given in Fig. 21 ; the speed-durability curves produced in cutting this steel, in Fig. 35. Now if we assume, as we have

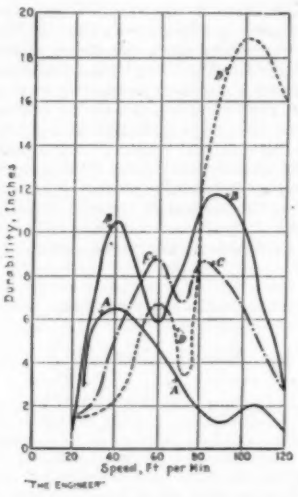


FIG. 35—SPEED-DURABILITY CURVES ON TOOL-STEEL TESTING MACHINE

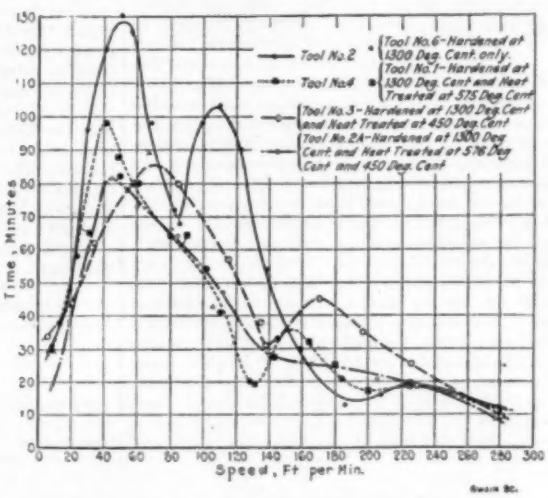

Tool No.2
Tool No.4
Tool No.6-Hardened at 1300 Deg. Cent. only.
Tool No.1-Hardened at 1300 Deg. Cent and Heat Treated at 575 Deg. Cent.
Tool No.3-Hardened at 1300 Deg. Cent and Heat Treated at 450 Deg. Cent.
Tool No.2A-Hardened at 1300 Deg. Cent and Heat Treated at 576 Deg. Cent and 450 Deg. Cent.
Time, Minutes
Speed, Ft per Min.

FIG. 36—SPEED-DURABILITY CURVES ON BAR LATHE

grounds for assuming—Fig. 18—that a tool cutting with water at 20ft. per minute on the testing machine generates a temperature rather below 100 deg. Cent.—212 deg. Fah.—it will be seen—Fig. 21—that the test tube is then in the condition P1 in which its work-hardening properties are at a maximum. If we now suppose the speed and cutting temperature to be raised, and assume, as we must, that a decline in work-hardening of the tube will be accompanied by increased durability of the tool, it is apparent that the speed-durability curve produced on the Vickers steel will be one in which the durability increases from a low value at low speeds to a maximum durability corresponding to the minimum work-hardening at the D2 temperature, and that there will be a second maximum durability corresponding to the minimum work-hardening at the D3 temperature. The speed-durability curves of tools cutting this steel must assume the general form which experience has shown them to assume.

Similarly with Dempster Smith's lathe curves—Fig. 36—produced on bars of steel whose work-hardening characteristics are shown in Fig. 22, it is evident that the durability of tools cutting this steel should increase from a low value at the P1 temperature to a maximum at the D2 temperature, and decline to a minimum corresponding to the P2 temperature. The general form of the curve can be thus accounted for.

It is not suggested that the durability of the tool and the changes taking place in the tool are of slight importance. The quality of the tool is indeed the predominating influence in the durability curve, whether produced on the testing machine or the lathe, but the features of the curve which are rightly attributed to the quality of the tool must be regarded as superimposed on a curve whose general form is determined by changes in the work-hardening properties of the material operated upon.

While it is true that this consideration introduces an element of complexity into the interpretation of the speed curves, it does not destroy their validity in estimating the quality of cutting tools, since the characteristic changes shown in the typical curve of Vickers steel—Fig. 21—have been found to occur in almost every variety of steel that has been tested, and the principal change, the D2 depression, always occurs in steel at approximately the same temperature, 120 to 140 deg. Cent.—248 to 284 deg. Fah. The behaviour of the tool cutting Vickers steel test tube is therefore the behaviour that may be anticipated in cutting any other steel.

Conclusions.

A tool cutting a ductile metal work-hardens the metal before cutting it. In so far as the machinability of a metal depends on hardness, it must therefore depend on the hardness induced by the tool and not on the original hardness.

Metals differ greatly in their capacity to work-harden. This capacity is capable of measurement by a test comprising a succession of alternate rolling operations and hardness measurements on the same spot. The hardness so induced and measured increases to a maximum, and declines with further rolling. The "maximum induced hardness" is a measure of the principal factor in the machinability of ductile metal

Cast iron, though capable of being hardened by cold work, is not appreciably hardened by a sharp cutting tool. Its work-hardening capacity is not generally a factor in its machinability, though it may be under special conditions. Other metals, such as brass, are intermediate between cast iron and steel in respect to the degree of plastic deformation and of work-hardening caused by the tool, and in respect of the influence of their work-hardening capacity on their machinability.

The built-up edge is the actual cutting implement when obtuse-angled tools are used on ductile metal, and is formed by the welding together of successive layers of metal derived from the zone of separation. It is much harder than the metal from which it is built up, and assumes a cutting angle appropriate to the cutting conditions under which it is formed.

Tools of high-speed steel when cutting at maximum output generate temperatures approximating to 500 deg. Cent.—932 deg. Fah.—even when artifically cooled. This temperature occurs where the chip impinges on the tool. It is the maximum cutting temperature and the temperature which the tool must be capable of withstanding without softening. A temperature gradient exists in the metal ahead of the tool, and the separation of the chip takes place at a point on this gradient which is not exactly determined, but is much below the maximum cutting temperature.

Steels, non-ferrous alloys and pure metals undergo a series of remarkable changes at temperatures generally below 300 deg. Cent.—572 deg. Fah. These changes are manifested by fluctuations in their capacity for work-hardening. Six definite change points, three maxima and three minima, generally occur in steels, and of these at least five are usually capable of identification in non-ferrous metals and alloys. The principal change is a low work-hardening capacity occurring in steels at 120 to 140 deg. Cent.—248 to 284 deg. Fah.—and in brasses and bronzes and some pure metals at 40 to 70 deg. Cent.—104 to 176 deg. Fah. From the fact that analogous changes occur in metals dissimilar in physical characteristics, it is to be inferred that the changes are connected with that which is common to all of them, namely, their crystalline structure. Changes analogous in character, in sequence, and in the temperatures at which they occur have been found in the limit of proportionality in torsion in the case of steel.

The changes in work-hardening capacity are not known to affect the structural uses of metals, but have a marked effect on their resistance to severe deformation such as occurs under the action of cutting tools. In particular the decline in work-hardening capacity of steel at the D2 or "free cutting range" of temperatures, about 130 deg. Cent.—266 deg. Fah.—is accompanied by a lessened vertical force on the tool, a lessened generation of heat, a different character of chip, a smoother finish on the cut surface, and a great increase in the durability of the tool when cutting within that range of temperatures.

Practical Applications.

It is not generally practicable or desirable to determine the cutting conditions so that cutting takes place in the free cutting range of temperatures, though this may be done in the case of metals which are extremely difficult to cut any under other conditions. There is, however, reason to believe that the form of the work-hardening curve can be modified, and in particular that the D2 depression corresponding to the free cutting range can be made deeper and wider by previous heat treatment of the metal and perhaps by modifying its composition. A metal so treated offers a slight resistance to cutting over a wide range of cutting temperatures and can therefore be cut freely under a wide range of cutting conditions, speed, feed and

* Paper presented at the annual meeting of the American Society of Mechanical Engineers, New York, December 6th to 9th, 1926.

depth of cut. This is a subject ripe for investigation by metallurgists.

Although in metal-cutting operations it is not generally practicable to determine the cutting conditions with reference to the D2 range of temperatures, there may be other metal-forming operations, notably press work, in which, by a suitable regulation of working temperature, advantage may be taken of the D2 decline in work-hardening capacity. This has been found practicable in working certain refractory sheet metals, and the subject is now under investigation.

Since the limiting factor in the productivity of metal-cutting operations is the inability of the tool to withstand without injury the temperature generated in cutting, an advance in productivity may be sought:—(*a*) By providing metals which can be cut at higher speeds without generating excessive temperature; and (*b*) by providing tools capable of withstanding higher temperatures without being softened. These lines of advance can only be followed by studying (*a*) the effect of temperature on the work-hardening properties of metals, and (*b*) the effect of temperature on the hardness of tools.

In order that a tool may cut a given metal, the tool must be harder than the metal. In order that the tool may cut the metal without undue wear, the hardness of the tool must exceed the hardness of the metal in a certain minimum ratio. Since cutting heats the tool and hardens the metal, the significant hardness ratio is that between the hot hardness of the tool and the work-hardened or induced hardness of the metal. The cold hardness of the tool and the original hardness of the metal have little significance in relation to the ability of the one to cut the other under conditions of high productivity. This can be illustrated by an example taken from practice.

Two tools A and B were required to cut a certain steel X. Their respective cold hardnesses were:—

Tool A, *d T* 47 = 635 Brinell. Tool A was hard.
Tool B, *d T* 43 = 580 Brinell. Tool B was moderately hard.
Steel X, *T* 18 = 116 Brinell. Steel X was dead soft.

The hot hardness of the two tools is shown in Fig. 37.

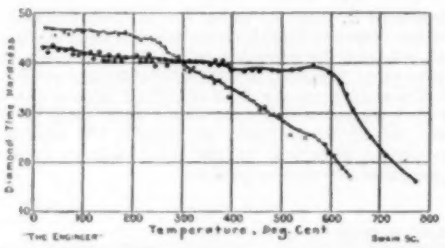


FIG. 37—HOT-HARDNESS CURVES. TOOL A, CROSSES; TOOL B, DOTS

They were placed in the electric furnace and tested with the pendulum and 1 mm. diamond at temperatures rising from cold to the softening temperatures.

Steel X was tested with the pendulum time work-hardening test and was found to have a maximum induced hardness 44 equal to 440 Brinell.

At 300 deg. Cent.—572 deg. Fah.—(cutting temperature) tools A and B had equal hardness (see Fig. 37) *d T* 40 = 540 Brinell. Both were harder than the maximum induced hardness of X (440 Brinell) and would cut it.

At 400 deg. Cent.—752 deg. Fah.—tool A had hardness *d T* 34 = 460 Brinell, which is little more than the maximum induced hardness of steel X. It could not cut it. Tool B had hardness *d T* 39·5 = 535 Brinell. It was harder than steel X and would cut it.

At 560 deg. Cent.—1040 deg. Fah.—tool A still retained hardness 39·5 (535 Brinell). It would still cut steel X. Tool B was quite soft.

The inference is that the hard tool A would be incapable of cutting the dead soft steel X except at slow speeds. The softer tool B should be capable of cutting steel X at quite high speeds, but would wear rapidly owing to the rather low tool work-hardness ratio. A tool having higher hot hardness would be desirable.

Tool A was a hacksaw blade containing 2 per cent. tungsten.
Tool B was a hacksaw blade containing 18 per cent. tungsten.
Steel X was stainless steel.

Both blades were set to cut stainless steel dry at 146 strokes per minute. Blade A failed in a few seconds. Blade B made several cuts, during which it became red hot, but blunting was somewhat rapid.

It is self-evident that anyone concerned with the efficiency of high-speed tool steel should be familiar with the hot-hardness curve of the particular steel and hardening process employed. Such a curve is easily made, but takes time and softens the steel. It is neither practicable nor necessary to make a complete curve in order to check the hot-hardness of tools in quantity. It is practicable, however, to fix a limit below which the hot hardness must not fall, for example, diamond time hardness 40 at 550 deg. Cent.—1022 deg. Fah. This involves a single test, occupying a few seconds, on the hot tool. It can be carried out immediately after the secondary heat treatment. If, by improvement in the steel or in the hardening process, the limit can be raised, the efficiency and output of the plant can be correspondingly increased. The cold-hardness test gives no important information and can be omitted. The efficiency of high-speed steel depends on hot hardness and can only be ascertained by testing it hot.

The author expresses his grateful acknowledgment of valuable assistance rendered by Brown Bayley's Steel Works, Ltd., Sheffield, in preparing and supplying many specimens of stainless steel; to J. J. Sayville, Ltd., Sheffield, for stainless iron; and to Hadfields, Ltd., Sheffield, for manganese steel used in these experiments.

AN exhibition of British goods is to be held in Melbourne in February, 1928.

Letters to the Editor.

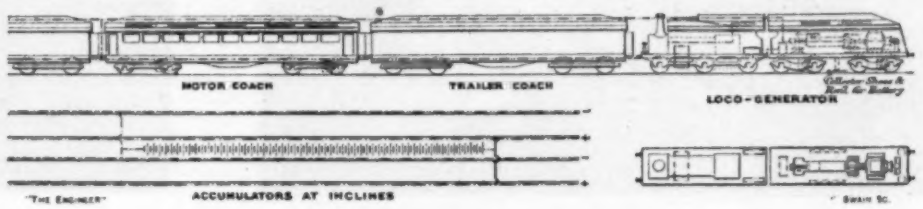
(We do not hold ourselves responsible for the opinions of our correspondents.)

THE REID-MACLEOD STEAM TURBINE LOCOMOTIVE.

SIR,—I read with great interest the article in your issue of February 4th on the Reid-Macleod steam turbine locomotive. It is of particular interest to me in view of a description and drawing contributed by myself and published by the Institution of Civil Engineers in connection with a paper by Messrs. Mordey and Jenkin on "Electrical Traction on Railways" nearly twenty-five years ago. [Note:—Paper No. 3331 in the "Minutes" of the Institution of Civil Engineers.] I think it may be of historic interest to your readers, and especially those interested in locomotives and electric traction generally, and I shall be obliged if you will print the extracts I have marked.

I am informed that locomotive builders in Britain are paying royalties to foreign inventors in connection with locomotives of this character.

The drawing, it will be seen, has a great likeness to the general elevation of the Reid-Macleod turbine locomotive in your double-page illustration, but the transmission of the effort from the engine conveyed to the driving wheels is, in my proposal, electrical instead of by means of gearing. My idea includes the application of power to the train as a whole by use of the multiple unit system, the benefits of which are so well recognised.



SIR ERNEST MOIR'S PROPOSAL, 1902

I am convinced that the progress of traction on our railways is dependent for economy on some such system as I described, and I thought in 1902 it was worth publishing my proposals to prevent possible royalties being imposed on our locomotive builders. It has taken a long while for the idea to develop, and in the locomotive under review confined as the tractive effort is to gearing and the locomotive wheels alone, I submit that the scheme cannot have full development. The application of what is virtually a travelling generating station to our tractive problems of to-day will, among other things, reduce the axle load where heavy adhesive weight is demanded, and thus materially reduce the loads on our floor systems on many of our railway bridges.

ERNEST MOIR.

10, Victoria-street, S.W. 1, February 10th.

[EXTRACT FROM INSTITUTION OF CIVIL ENGINEERS "PROCEEDINGS."]

If a modern high-speed triple-expansion engine could be put on a truck and run as part of the train, somewhat on the lines of the Heilmann locomotive, he thought there was room for economy between the 33½ per cent. saving in fuel and a possible loss of 15 per cent. in the conversion of energy between the generator and the motor on the wheels. Such a train would be fitted with motors on the multiple-unit system, from which the advantage of rapid acceleration, already pointed out, would be gained, and reciprocating parts would be done away with. He thought the wear and tear would undoubtedly be less for passenger traffic, the cost of maintenance of the boilers would be reduced, and the design of the boilers could be modified to make them more easily cleaned and possibly more efficient. The point of greatest importance, however, in obtaining economy, would be to keep the high-speed engines running with a high load factor. That was the difficulty with the ordinary locomotive; it had to be powerful enough to mount steep gradients, and did no work at all in running downhill. He suggested that, in order to ensure the engine running at full load factor all the time, it was possible to have a third conducting rail at stations and on steep gradients and inclines, so that when the train stopped the engine might continue to run, sending current through the third rail to a storage battery in the station, which would store the current ready to assist in starting a train and in lighting the station. On steep inclines a similar method of working could be adopted; the engine when running down the incline could be paying into the third-rail system current which could be stored in a storage battery not requiring much attention, and that current could be utilised for assisting a train running up the hill. The carrying of the generator on the train was no new idea; but he was not aware whether the plan mentioned had been suggested previously as a possible means of maintaining a high load factor. If that could be done, the high-speed engines would certainly show better results than the locomotive in coal consumption. The third-rail equipment could be used for absorbing the energy recovered in braking. Where electrical haulage was most likely to gain over any other system was in returning energy to the line when braking was required, or when the trains were running down steep gradients. Such a third-rail system would be a means of introducing electrical traction tentatively, combining it at first with the use of ordinary steam locomotives, without the expenditure of £20,000,000 to which Mr. Webb had alluded. The trains could be fitted up and introduced gradually, and the storage batteries could be added to as the number of trains driven electrically was increased. Were such a system introduced, the trouble of steep gradients would be obviated to a large extent. If a train running downhill and storing energy could help to pull another train up the incline, it would be an immense advantage, for lines could be laid out with steeper gradients and therefore be constructed much more cheaply.

INDUSTRIAL WELFARE SOCIETY.

SIR,—The increasing confidence in the revival of trade has resulted in a considerable growth in the number of inquiries which the Industrial Welfare Society receives on matters relating to staff welfare and the management of *personnel*.

By pooling the experience of its 700 member firms, this organisation is able to give trustworthy advice on the many activities associated with industrial welfare work, and is thus able to fulfil the important function of a clearing house for information of this kind.

In order that the service may be comprehensive and up to date, it is very desirable that as many firms as possible should co-operate. Since it would occupy a great deal of space to tabulate the many subjects on which information is wanted, may I, through your columns, invite any employers who are willing to give others the benefit of their experience, to send a postcard to 51, Palace-street, Westminster, London, S.W. 1?

ROBERT R. HYDE,
Director, Industrial Welfare Society.

February 11th.

HIGHER PRESSURES IN BOILERS AND I.C. ENGINES.

SIR,—The trend of present-day practice in boiler and steam turbine design appears to indicate that ere long pressures of the order of 1500 lb. per square inch will become standard, in which case thermal efficiencies will be achieved which will more seriously than ever challenge the heavy oil internal combustion engine.

It was to be inferred from Mr. Chorlton's paper of a few months back that high efficiency in heavy oil engines is to be sought in increased piston speeds and improved fuel injection and combustion, rather than in higher compression pressures. In the discussion, it was pointed out that the increased fuel economy due to high compression would probably be counterbalanced commercially by the greater capital cost of the engine.

In spite of this state of affairs in the case of the heavy oil engine, steam engineers are beginning to recognise that the heavy construction required by high boiler pressures is an economical proposition.

I should be gratified to learn the opinion of any correspondent interested in heavy oil engines as to the question of increased compression. The blast pressure in Diesel engines is in successful daily operation at nearly 1000 lb. per square inch—sometimes 1200 lb.—in countless engines.

What are the objections to carrying the compression in the working cylinder to 1000 lb. or even 1500 lb. per square inch? How would it be suggested to meet the difficulties of (1) combustion space volume, (2) removal of heat, (3) strength of cylinder and piston, (4) the severe conditions imposed upon the valves, (5) cylinder lubrication, and (6) strength of bearings and bearing pressures?

F. J. B. MAGGS.

Southern Siam, January 10th.

THE INSTITUTION OF CIVIL ENGINEERS.

THE sixth annual dinner of the Manchester and District Association of the Institution of Civil Engineers was held at the Midland Hotel, Manchester, on Wednesday, 9th inst. The chairman of the Association, Mr. S. J. Watson, M. Inst. C.E., presided, and amongst the guests were the President of the Institution, Mr. Frederick Palmer; Sir Murdoch MacDonald; Mr. H. F. Massey, chairman of the North-Western Branch of the Institution of Mechanical Engineers; and Sir Benjamin Longbottom, M.I. Mech. E., President of the Manchester Association of Engineers. The toast "The Institution of Civil Engineers" was proposed, as usual, by a student, and on this occasion the honour fell upon Mr. P. V. Marchant, who is connected with the engineer's department of the Salford Corporation. Mr. Marchant, in the course of a neat speech, said that the young men appreciated the advantages conferred upon them by the Institution, and would strive to emulate the *esprit de corps* of the founders. In responding to the toast, Mr. F. Palmer, the President, had a good deal to say concerning the opportunities which India offered as a training ground for young engineers. Referring to the affairs of the Institution, Mr. Palmer said that its membership was growing, and now reached over 10,000, including two women. The toast "The Manchester and District Association" was proposed by Sir Murdoch Macdonald, who said that the Council was doing all it could to help the local associations. Mr. S. J. Watson, in his reply, said that there was a place in the Institution for all kinds of engineers. He urged very strongly the proposal that the Institution should have provincial summer meetings like the other societies, and he also urged the desirability of direct representation of the local sections on the Council, as was the case in the "Mechanicals" and "Electricals." The only other toast, that of "The Guests," was proposed by Mr. G. C. Lynde, Past-president of the Association, and was responded to by the Mayor of Salford.

IT is announced in the Russo-British Chamber of Commerce *Journal* that the construction of the main line of the Turkestan-Siberian Railway, which will be 1400 kilom. in length, will be begun during the current year. The line will connect a number of important towns in the territory served, among them being Alma-Ata, Semipalatinsk and Sergiopol. It is estimated that the railway will take five years to complete, and that the cost will amount to 140,000,000 roubles. The construction of this railway will undoubtedly have a stimulating effect on the development of the vast natural resources of Western Siberia and Central Asia.

Birmingham Water Supply: Bartley Reservoir.

THE construction of the Bartley Reservoir is a step in the considered policy of the Water Committee of the Corporation of Birmingham for developing the Elan supply. Since 1912 the Committee has been advised and has recognised that, not only is there a growing need for increased capacity in the Elan Aqueduct, but also that very much greater storage is required at its Birmingham end than is afforded by the existing Frankley Reservoir with its 200,000,000 gallons. The existing reservoirs in the Elan Valley are capable of supplying to Birmingham an average daily quantity of at least some 36,000,000 gallons. To-day the Elan Aqueduct, despite the lengths of third main recently added to it, is only capable of delivering, at the utmost, a little more than two-thirds of that quantity daily to Birmingham, or about 24,000,000 gallons, whilst the demand for water in the city is already up to an average of about 26,000,000 gallons a day, and will, no doubt, grow with the improvement of trade and the extensions, now being carried out, of the distribution mains, particularly in connection with housing.

To meet the excess of demand over the aqueduct capacity, the old sources of supply at Whitacre, Aston and Short Heath are utilised, but their capacity is strictly limited, and limited in two senses. Not only is their daily capacity small compared with that of the Elan Aqueduct, but they have very little storage. With the growth of demand, the excess of peak demands over the normal naturally becomes greater, and it has been decided that it is cheaper, in view of the length of the aqueduct, to provide increased storage in the neighbourhood of Birmingham to meet peak demands than to increase the capacity of the aqueduct to make it capable of bringing in more water.

By the courtesy of Mr. F. W. Macaulay, M. Inst. C.E., the chief engineer of the Water Department, we are able to place before our readers the following particulars of the new reservoir, as well as the drawings and other engravings which accompany this article.

A site for the new reservoir was found close to the termination of the Elan Aqueduct and adjacent to the existing Frankley Reservoir, where the requisite volume of storage can be obtained with a top water level of 605 O.D. The reservoir will be connected at its western end with the aqueduct by a short branch inlet channel, and the controls will be so arranged that the flow from the aqueduct can be directed, at will, either into the new Bartley Reservoir, or into the existing Frankley Reservoir, or into both at once in any desired proportion. The inflow into the reservoir will be gauged. The reservoir itself will be of the impounding type, that is to say, it is being formed by throwing an earthwork embankment across the valley near the head of the small stream on which is being constructed, and allowing the water to pond up behind it. All the water flowing from rainfall on the land surrounding the reservoir will be intercepted and led past the reservoir to a point below the embankment. The lake formed will be about two-thirds of a mile long, rather over one-third of a mile wide at its greatest width, and about 60ft. deep at the dam, tailing out to about 5ft. deep at the inlet end. Its surface area will be 125 acres, and its content upwards of 500 million gallons.

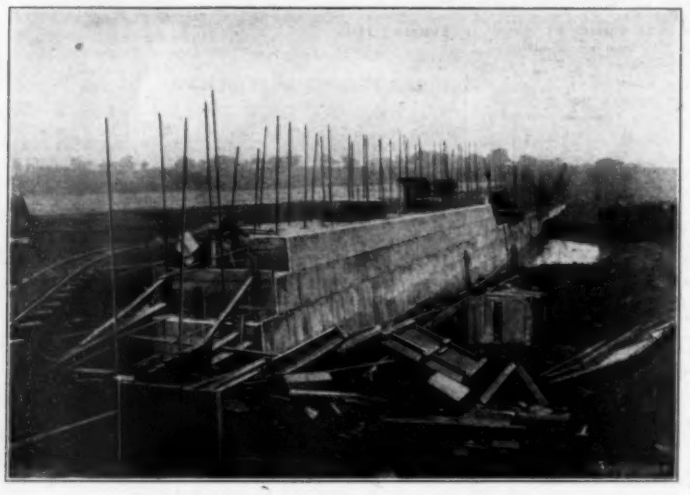


FIG. 1—GENERAL VIEW OF CORE WALL

FIG. 2—CONDITION OF CORE WALL AT END OF 1926

FIG. 3—VIEW ALONG TOP OF CORE WALL, SHOWING REINFORCEMENT

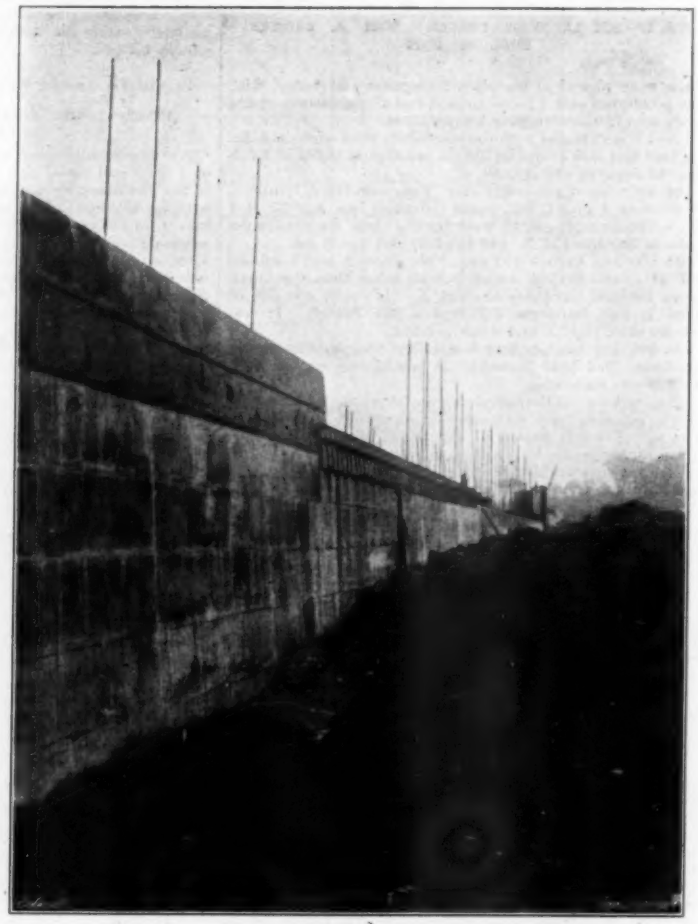


FIG. 4—UPSTREAM ELEVATION OF CORE WALL

The site is covered with practically impervious red marl of considerable thickness, interspersed with beds of open red sandstone. Most of these sandstone beds are very thin. One, however, which is from 12ft. to 20ft. thick, practically outcrops in the stream bed at the dam site, but as it slopes north and southwards from that point it is some 80ft. or 90ft. below the surface in the hillsides at the ends of the dam.

With a view to saving expense the usual method

of constructing a deep underground concrete diaphragm has been abandoned. For it has been substituted cementation under pressure of the rock bed throughout the entire length of the dam and for a considerable distance at the north and south ends of the dam up the sides of the reservoir. This cementation work was carried out in 1923 and 1924 by the François Cementation Company. Boreholes 4in. in diameter were drilled at intervals of 30ft. along the centre line of the proposed embankment and also along the lines of each arm trench for a distance of 450ft. up the valley. The depths of the holes ranged between 80ft. and 150ft., and the total quantity of cement injected was 4630 tons, the maximum amount used in an individual hole being 274 tons.

In the absence anywhere in the neighbourhood of any considerable deposits of clay suitable for the construction of the usual puddle clay core wall the latter is being constructed of reinforced concrete. The basin of the reservoir will be the natural valley stripped of all soil and vegetable growths, and, to prevent discolouration of the water by the marl, it is being covered, as to the upper 15ft. below top water, with reinforced concrete slabs, and below that level with gravel beaching.

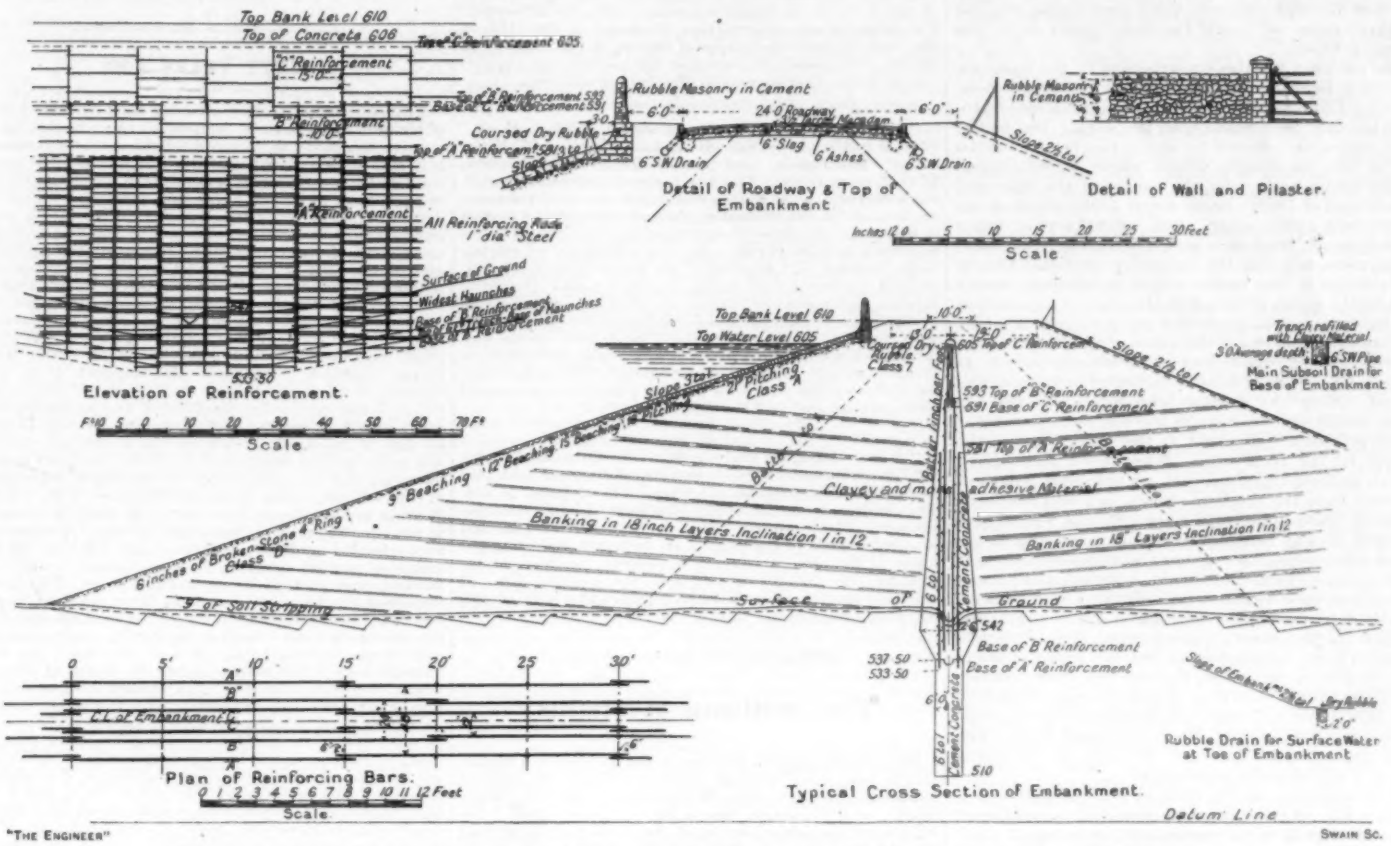


FIG. 5—TYPICAL SECTION THROUGH EMBANKMENT AND CORE WALL, AND DETAILS OF CORE WALL REINFORCEMENT

In the absence anywhere in the neighbourhood of any considerable deposits of clay suitable for the construction of the usual puddle clay core wall the latter is being constructed of reinforced concrete. The basin of the reservoir will be the natural valley stripped of all soil and vegetable growths, and, to prevent discolouration of the water by the marl, it is being covered, as to the upper 15ft. below top water, with reinforced concrete slabs, and below that level with gravel beaching.

mulate up to the level of this pipe. The parapets of the old bridge over the original stream, seen in the engraving, have been submerged since the photograph from which the illustration was made was taken. The material for forming the embankment was obtained from excavations around the margin of the reservoir. These excavations are being trimmed off to a regular slope of 3 to 1 throughout, and the inner slope is being covered with 6 to 1 concrete 4½in. thick. A portion of this work is shown in Fig. 8. It has been found possible to place this concrete *in situ* in panels 7ft. wide. Fig. 9 shows this work in progress.

The water will be drawn off through valves fixed at different levels in a concrete and masonry tower, into a 5ft. diameter concrete lined steel pipe, which

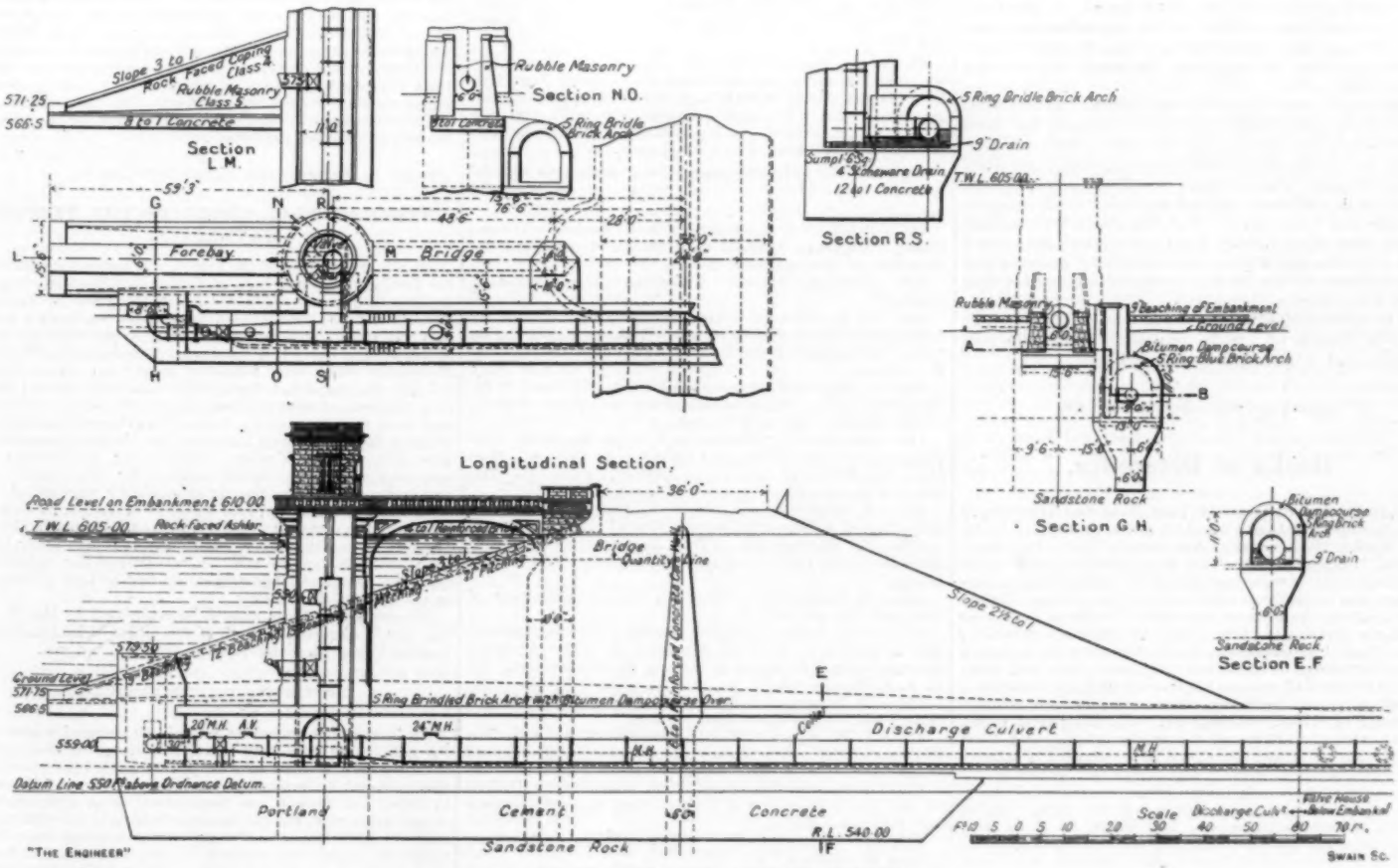


FIG. 6—VALVE SHAFT AND DISCHARGE CULVERT

Fig. 7, page 186, shows the gravel lining on the basin of the reservoir. The lower portion of the inner slope of the embankment appears on the left of this view, and the forebay to the lowest draw-off pipe is to be seen in the centre. Water is being allowed to accu-

will lie in a masonry culvert that passes through the core wall, and thence into a pressure tunnel some 900 yards long under the ridge between the two reservoirs, Bartley and Frankley. The tunnel will have a finished diameter of 6ft. 3in., and will be lined with cast iron segment plates, finished to a smooth face with concrete. From the end of the tunnel the water will flow through concrete-lined steel pipes into the existing system of mains for distribution on to the Frankley filters.

The contract for the construction of the reservoir was let in February, 1925, to Edmund Nuttall, Sons and Co., Ltd., of Manchester, and considerable progress has now been made with the work. The bed of open sandstone referred to above has been removed by the 6ft. diaphragm trench where it outcropped in the stream bed under the centre of the dam and for a length of 700ft., being about 250ft. north of the stream and 450ft. south of it. That was a rather greater length than was anticipated, but was found to be necessary for the following reason. During cementation it was realised that satisfactory results were likely to be obtained if the cement injected at one borehole could be forced up the next borehole 30ft. away. This result was often obtained where the superincumbent marl was of sufficient depth to prevent an upflow of cement through the surrounding ground. Near the stream, however, where the top of the sandstone was near to the surface, the cement during injection leaked out at the surface before the fissures in the rock were impregnated thoroughly. It was realised therefore that an unknown length of the rock near the original stream bed had not been rendered watertight, and a provisional length was inserted in the contract schedule over which the trench was intended to cut out the whole of such rock. At the points above mentioned, however, the fissures in the rock were found to be well filled with cement, and the bed itself was practically dry. North and south from this point, consequently, the diaphragm trench is being founded at an average depth of about 20ft. to 25ft. in full below the surface. The concrete wall foundations have now been put in for a length of over 1470ft., and the concrete core wall has been carried up to a level about 35ft. below top bank level. The main embankment has been brought up on either side of it to a slightly higher level.

A general view of the work at the embankment is given in Fig. 10, page 186, and details of the reinforced core wall appear in the remaining engravings.

The reinforcement consists of mild steel bars 1in. in diameter placed both horizontally and vertically, and the wall is being built by means of "Blaw-forms" in lifts 2ft. high. Fig. 1 shows the work in progress with the embanking being tipped against the wall. Fig. 2 shows practically the whole length of the core wall as at the end of last year. Fig. 3 gives a view on top of the wall showing the reinforcement in position; and Fig. 4 illustrates the upstream elevation of the wall with one set of "Blaw-forms" in position.

A typical cross-section of the embankment and core wall is given in the drawing—Fig. 5—while Fig. 6 shows a section through the discharge culvert and valve shaft.

The outlet culvert which was founded in the solid towards the south end of the embankment, has been constructed, and a 60in. concrete-lined draw-off pipe laid in it. In the bed of the reservoir about one-third of the area has been stripped of soil and covered with beaching in the lower portion and reinforced concrete towards top water level. The 6ft. diameter pressure tunnel has very nearly been completed and lined with cast iron segments. The necessary intercepting pipes to carry off the surface water from the surrounding country have all been laid.

It is estimated that the work will cost altogether about £500,000, of which sum about £230,000 had been expended up to the end of last year.

Books of Reference.

"THE British Waterworks Year Book and Directory," 1926, has recently been published at the price of £1 1s. by the British Waterworks Association, 173, Rosebery-avenue, London, E.C. 1. This first edition of a new book of reference deals with just under 250 waterworks undertakings, the majority of which are in this country, though some that are overseas are included. The book is divided into three parts:—(I.) Directory; (II.) Statistical tables; (III.) General information. In the directory the names of the undertakings included are given in alphabetical order with particulars of various kinds, including, in most cases, the office, names of officials, sources and limits of supply, character of water, charges, &c. The statistical tables occupy some two-fifths of the whole volume, and their compilation must have involved an immensity of labour. There are eleven of them. The first gives particulars of sources of supply, catchment areas, impounding reservoirs, wells and bore-holes, pumping power, bulk supplies lengths of aqueducts, if any, &c. Table II. deals with "Filtration and Distribution," and contains data concerning filters—slow-sand and mechanical—service reservoirs, trunk distribution and service mains, number of revenue meters in use, &c. Table III. treats of supplies and gives quantities in thousands of gallons, whether by gravitation or pumping, bulk supplies and compensation. Table IV. is concerned with population, services, supply per capita, &c. Tables V. (*a*) and V. (*b*) contain analyses of accounts of municipal and company undertakings, respectively, both in great detail. In Table VI. are set out the annual domestic charges for residential property; while Table VII. shows the annual charges for shops and offices without residential occupation; and Table VIII. gives the charges for water by meter per quarter per thousand gallons. Table IX. sets out the rents per quarter for meters of various sizes; and Table X. gives particulars of public water rates, bulk supplies, &c. The tables as a whole contain a vast amount of information which should prove of much value to those concerned with water supply. The miscellaneous information contained in Part III. of the book includes the names of officers of the Ministry of Health, the British Waterworks Association, the Institution of Water Engineers, and of other associations.

"THE *Mechanical World* Electrical Pocket Book," 1927, is published by Emmott and Co., Ltd., of 65, King-street, Manchester, and 20, Bedford-street, London, W.C. 2, price 1s. 6d. The new features appearing in this, the twentieth, issue of this useful little book of reference are sections on (*a*) alternating-current commutator motors in which the principles of construction of various types are described and illustrated; (*b*) time switches; (*c*) electric signs, flashers and dimmers; (*d*) recent designs of controlling apparatus; (*e*) electric pumping; and (*f*) electric lighting and power in villages, in which various systems of supply are considered and much data given, particularly with regard to the power required for driving village and farm machinery. Other sections in the volume have been revised and new illustrations introduced. We notice that the compiler has still been able to resist the temptation to insert a section on "Wireless."

"A LIST of English Clubs in All Parts of the World" for 1927 is published by Spottiswoode, Ballantyne and Co., Ltd., New Street-square, London, E.C. 4, price 7s. 6d. This book, now in its twenty-fifth year of issue, contains the names of very nearly 4000 clubs in the British Isles and in various parts of the world. In each case, following the name of the club, are given its address, the year it was founded, the number of members, the entrance fee and subscription, the name of the secretary, and a word or two describing the special object of the club.

The Institute of Metals.

THE annual general meeting of the Institute of Metals will be held in the Hall of the Institution of Mechanical Engineer's, Storey's Gate, Westminster, S.W. 1, on Wednesday and Thursday, March 9th and 10th, 1927. On March 9th the annual dinner of the Institute will be held at the Trocadero Restaurant, Piccadilly-circus, W. 1, at 7 p.m. The dinner, at which there will be a shortened toast-list, will be followed by a dance ending at midnight.

PROGRAMME.

Wednesday, March 9th.—10 a.m.—12.30 p.m.—General meeting. Presidential address. Papers Nos. 418, 419, together, and (416) will be presented and discussed. 2 p.m.—4 p.m.—Paper No. 427 will be presented and a general discussion on "Electric Furnaces in Non-ferrous Metallurgy" will follow. 6.45 p.m. for 7 p.m.—Annual dinner and dance.

Thursday, March 10th.—10 a.m.—12.30 p.m.—The adjourned meeting will be resumed. Papers Nos. 430, 425, 431 (together), 424 (421, 422) will be presented and discussed. 2 p.m.—4 p.m.—Papers Nos. 417, 428, 423 (415, 429, 420, 426) will be presented and discussed. The meeting will be brought to a conclusion.

Papers.—The following papers are expected to be submitted:—

Serial No.

415.—Professor Kôtaro Honda, and Professor Hikozo Endo, "Magnetic Analysis as a Means of Studying the Structure of Non-magnetic Alloys."

416.—Clement Blazey, "Brittleness in Arsenical Copper."

417.—J. D. Grogan, "The Influence of Calcium on Aluminium Containing Silicon." With an appendix on "The Estimation of Calcium in Aluminium Alloys," by P. G. Ward.

418.—Professor D. Hanson and Grace W. Ford, "Investigation of the Effects of Impurities on Copper. Part V.—The Effect of Bismuth on Copper."

419.—Professor D. Hanson and C. B. Marryat, "Investigation of the Effects of Impurities on Copper. Part III.—The Effect of Arsenic on Copper. Part IV.—The Effect of Arsenic plus Oxygen on Copper."

420.—J. Newton Friend and W. E. Thorneycroft. "Examination of a Fifteenth Century Brass."

421.—F. Hargreaves, "The Application of Strain Methods to the Investigation of the Structure of Eutectic Alloys."

422.—F. Hargreaves, "Note on the Crystallisation of the Lead-Tin Eutectic."

423.—R. Genders, "The Mechanism of Inverse Segregation in Alloys." With an appendix on "The Accurate Determination of Copper in Bronze by Electrolysis," by R. A. F. Hammond.

424.—H. Moore and S. Beckinsale, "Notes on the Manufacture and Properties of Hair Springs."

425.—J. H. Miller, "The Penetration of Brass by Tin and Solder, with a Few Notes on the Copper-Tin Equilibrium Diagram."

426.—J. Newton Friend and W. E. Thorneycroft, "Note on the Silver Contents of Roman Lead from Folkestone and Richboro' Castle."

427.—D. F. Campbell, "Electric Furnaces in Non-ferrous Metallurgy."

428.—Max Hansen, "The Magnesium-Rich Magnesium-Copper Alloys."

429.—Professor Bernard W. Holman, "An Etching Reagent for Copper."

430.—R. Genders, "The Penetration of Mild Steel by Brazing Solder and Other Metals."

431.—Harold J. Hartley, "The Attack of Molten Metals on Certain Non-ferrous Metals and Alloys."

Order of Discussion.—The papers will be presented and discussed, as far as possible, in the following order:—March 9th.—Morning, Nos. 418, 419 (416); afternoon No. 427. March 10th—Morning, Nos. 430, 425, 431, 424, (421, 422); afternoon, Nos. 417, 428, 423 (415, 429, 420, 426).

Autumn Meeting.—The annual autumn meeting will be held in Derby from September 6th—9th, 1927.

SIXTY YEARS AGO.

THE engineer of to-day, glancing back over the history of his profession, must be tempted at times to sigh for the relative simplicity of things mechanical as they were in, say, the 'sixties of last century, and to envy the opportunities for improvement and advance which, as we now can see, were at almost every turn presented to our predecessors. It is very easy, however, to fall into a wrong impression in this matter. We are accustomed to-day to complaints of the overcrowded nature of the profession and of the lack of opportunity for the achievement of notable developments. It is a mistake to believe that the situation was greatly easier sixty years ago. The year 1866 was one of industrial panic. Numerous banking houses, many companies and contractors and one of our great railway lines had gone bankrupt. The public almost completely withdrew its support from large schemes of an engineering or similar nature, and both in the civil and mechanical branches of the profession there was a dearth of employment and much distress, so much so that in some establishments the Christmas vacation was prolonged far into February, 1867. It would appear, however, that the commercial embarrassment experienced in 1866 was not by any means the sole cause of the trouble. Writing in our issue of February 15th, 1867, we traced it in large part to a more fundamental factor. Engineering, we contended, no longer held the position it once did as a means of earning money. As a profession, it was overstocked, and had been for a number of years. The church, the army, the navy, the legal and the medical professions had long been crowded out by the elder sons, and with joy parents had discovered in engineering a new source of respectable livelihood, a "perfect paradise" for their younger sons. For twenty years the ranks of the profession had been recruited more rapidly than the expansion of its activities demanded, with the result that for important posts, offering but £200 or £300 as remuneration, at least twenty or thirty applications would be received. Simultaneously, it was becoming increasingly difficult to acquire the attainments of an engineer. The abilities demanded were greater than in earlier times, and it was to be feared, so we wrote, that in this respect the foreigner was beating us at our own game. To remedy the situation, we urged engineering employers to set their faces against the temptation of premiums and strictly to limit the number of pupils admitted to their establishments. To the young would-be engineer our advice was that he should cease to look upon engineering as a profession easily entered and demanding little study. Our continental rivals were fully alive to the value of technical education, and as a result of their superior elementary training they, and the Germans in particular, were ousting British engineers even from posts in this country. It was a discouraging review of the situation, as, no doubt, it was meant to be. We have heard many such remarks, all equally true, in our own time. But still, somehow or other, British engineering retains its prestige, still do we find it exercising its attraction as a career, and still to many does it provide a not impossible pittance on which to live. Sixty years hence, we may be sure, the engineers of the time will envy the spaciousness of to-day, and, like us, sigh for the opportunities of a former generation.

INTERNATIONAL CONGRESS FOR TESTING MATERIALS.

AT a joint meeting of the Dutch and Swiss Associations for Testing Materials, held at Zurich last October, it was decided to organise an International Congress for Testing Materials, to be held at Amsterdam on September 12th to 17th, 1927. This movement aims at the continuation of the work of the old International Association for Testing Materials, which was formally wound up about 1923. No new International Association has been formed, but it is understood that representatives of certain countries may wish to discuss at the Amsterdam Congress the possibility of bringing a new International Testing Association into being. The Testing Congress at Amsterdam is apparently receiving strong support by other countries, and is likely to be numerously attended by representatives from France, Germany, and the United States, as well as by those of the smaller countries such as Belgium, Holland, Sweden, Denmark, and Switzerland. It is also likely that the United Kingdom will be represented by delegates from the principal laboratories and institutions interested in the testing of materials.

All communications should be addressed to Mr. P. F. Van der Wallen or Dr. E. B. Wolff, Office of International Testing Congress, Valckenierstraat 2, Amsterdam.

AN instructive remark is made in the annual report for the year ended June 30th last of the Interstate Commerce Commission's Bureau of Safety. It is therein observed that since the Commission's investigation of power brakes in 1924, the Bureau has been working in sympathetic co-operation with the mechanical division of the American Railway Association, and the relations between these two bodies are highly satisfactory. A notable exception, however, to the general good spirit manifested by the railways is the case of the Terminal Railroad Association of St. Louis. That company appears to deem it less expensive to pay penalties than to comply with the law. It paid 13,000 dollars in penalties during the past year without contesting a single case. That course, says the report, defeats the purpose of the law, which is to secure improvement in practice.

Railway Matters.

THE consumption of fuel by oil burning locomotives of the Southern Pacific Railway is, according to official statistics, 10·53 gallons per 1000 gross ton-miles of goods, or 0·93 gallon per passenger car mile.

WITH the steady growth of Moscow, the present means of transport have become inadequate, and a scheme has therefore been prepared for constructing a metropolitan railway. According to this plan, which has been laid before the Moscow Soviet, there will be three lines of about four kilometres each; the work will take three to four years to carry out, and the estimated cost is approximately 18 million roubles—£2,000,000.

THE Italian Government has definitely approved the construction of a new railway between Rome and Bari, the Adriatic seaport with a population of over 120,000. The route will be *viâ* Campobasso, in the Apennines. The new line will reduce to 298 kiloms. the journey between Rome and Foggia, the junction of the coastal railway, the Benevento and Naples line, and branches of three other systems. The route leading to the European Orient and Egypt will also be much shortened.

AN interesting innovation has been made by the London Electric Railways Company at its recently opened Morden terminus. A motor garage has been opened with a view to the business man residing in that area using his car between his home and the station, and proceeding thence by train. The car owner would, it is thought, thus avoid a tedious journey through the streets of London, his possible difficulties as to stabling the car in the City would be met, and as the garage charge would be under 1s. a day, its cost would be more than covered by the petrol saved.

THE proposal, mentioned herein on November 12th, of the Great Western to abandon the Kennett and Avon Canal, has now, in view of the local opposition, been modified, and it is proposed that the canal remain and the company be relieved of all obligations necessary for traffic purposes. The questions now being asked are: What will be done to prevent the water becoming stagnant and offensive? What guarantee have the farmers on the line of route that they will have the water supply they have enjoyed for a hundred years? Will the locks and gates be kept in good repair?

FOLLOWING on the reference in this column on January 28th, as to the London County Council's housing scheme at Becontree and its influence on the existing railway facilities in East London, comes the announcement by the Mayor of Ilford that there was a possibility of the District Railway being extended from Barking to the Becontree estate. The railway company says, in reply to that suggestion, that it has not been approached, and, further, that any such extension would have to be made by the London, Midland and Scottish Railway. The meaning of that remark is that the District Railway ends at Campbell-road Junction, Bow, and thence, over the Tilbury section, London, Midland and Scottish, it runs to Barking.

A PRELIMINARY statement of the earnings of the Canadian Northern National Railways, exclusive of the Central Vermont Railway system, during 1926 gives the net earnings at 46,400,000 dollars, as compared with 32,264,414 dollars for 1925, an increase of 14,135,585 dollars, or 43·81 per cent. During 1926 the railway operating revenues amounted to 266,270,000 dollars, while in the previous year the total was 244,971,202 dollars. Operating expenses totalled 219,870,000 dollars as compared with 212,706,787 dollars in 1925. The increase in revenue during 1926 over the previous year amounted to 21,298,797 dollars, or 8·69 per cent. The increase of operating expenses for 1926 amounted to 7,163,212, or 3·37 per cent.

THE Ministry of Transport railway statistics for the month of November have recently been issued as a Stationery Office publication, price 2s. 6d. They show that, compared with the corresponding month of 1925, there was a decrease of 6·7 per cent. in the number of passenger journeys and one of 7·3 per cent. in the receipts from passenger fares. In passenger receipts from all sources the decrease was 5 per cent. The passenger train mileage was, however, only reduced by 1 per cent. Owing mainly to a fall of 44·4 per cent. in the tonnage of coal, coke and patent fuel, there was a decrease of 34·8 per cent. in the freight tonnage. The ton-miles were, however, only 14·8 per cent. less, and the freight train receipts 9·1 per cent. A saving of 11·5 per cent. was made in the freight train mileage.

ACCORDING to the Board of Trade returns the value of the railway material exported last year was as follows, the corresponding figures for 1925 and 1924 being added in brackets:—Locomotives £3,043,131 (£2,558,887, £1,851,537); rails, £1,347,623 (£1,896,960, £1,624,211); carriages, £2,732,908 (£1,619,601, £1,195,963); wagons, £2,731,984 (£3,671,191, £3,247,203); wheels and axles, £422,765 (£599,540, £547,294); tires and axles, £289,041 (£437,775, £605,524); chairs and metal sleepers, £638,639 (£1,023,332, £1,142,687); miscellaneous permanent way, £1,096,364 (£1,429,858, £1,169,328); total permanent way, £3,969,136 (£5,604,327, £5,306,457). The weight of the rails exported was 164,317 tons (207,615 tons, 174,711 tons), and of the chairs and metal sleepers, 65,618 tons (94,126 tons, 91,160 tons).

THE recent increase in railway rates has revived the correspondence in *The Times* as to rail and road transport. Lord Montagu of Beaulieu and Mr. Shrapnell-Smith, on the one side, and Mr. R. H. Selbie, of the Metropolitan Railway—who is the chairman this year of the Railway General Managers' Conference—on the other, have each told very convincing tales, which brought the suggestion in the issue of the 3rd inst. from Mr. William Graham that the Government should undertake a short but comprehensive review of the material provided by innumerable able committees, ascertain impartially and exactly the burdens which railways and the motor industry were carrying, and indicate whether any form of co-operation or complementary effort in public service was possible. In a leading article in the same issue *The Times* supported the suggestion in the interests, not only of the two parties concerned, but of the public.

Notes and Memoranda.

A RECENTLY issued official report on the prospects of getting oil from Alaska is not very encouraging, chiefly on account of the difficulties of transport. It is urged that a pipe line 1000 miles long would be necessary to deliver the oil at an ice-free port.

THE gold output for the Union of South Africa for the year 1926 was 9,962,852 oz., valued at £42,299,420, compared with 9,597,592 oz., valued at £40,767,982, for 1925. Both the quantity and the value constitute a record for any year in the history of gold mining in South Africa.

A SURVEY of petroleum pipe lines recently conducted by the American Bureau of Mines, shows a total of slightly more than 90,000 miles of pipe lines in the United States. This system has a capacity of approximately 15,750,000 barrels of crude oil, which is equivalent to one-fourth of the nation's average production for one month.

ACCORDING to the *Chemical Age*, it is now established that detonation in an engine using liquid fuel is of a chemical origin, being "due to the formation of organic peroxides which become concentrated in the nuclear drops during compression, and ignite them simultaneously when the detonation temperature of the peroxide is reached."

ACCORDING to *Industrial and Engineering Chemistry*, rubber is primarily adapted as a lining for ball mills for fine wet grinding. In dry grinding operations the application of rubber is limited because of the heat factor. Tests have shown that friction heat generated in the mill will build up, owing to the slow radiation through the rubber lining, to a sufficient temperature to cause premature failure, unless a large volume of air is forced through the mill to dissipate the heat. Oil and grease have a deleterious effect on rubber which precludes its use in grinding pigments in oil.

THE corona discharge probably has two effects when used during the cracking of oils—a chemical action and a mechanical or precipitating action. There is undoubtedly some direct chemical effect due to the use of the corona. Many investigators have studied both low and high-frequency discharges on different gases and vapours, and in virtually every case the investigators have reported some effects. The effect is, however, comparatively slight and in keeping with the relatively small amount of energy of the corona. The mechanical or precipitating effect may be important.

CAREFUL calculations made in connection with the contract for the 25,000 horse-power station required for the Comodoro Rivadavia oilfields in the Argentine, to find out whether Diesel engines or steam turbines would be the more economical form of motive power to adopt, proved conclusively that the turbine scheme was the more desirable, and this scheme has now been completed. The drawbacks to the Diesel scheme were its high capital cost and the high depreciation and interest charges. In addition, there were the higher maintenance costs and a more expensive fuel consumption when the station had only a partial load. The turbines are supplied by water-tube boilers heated by gas and oil firing.

DESCRIBING the process of asbestos mining in the Kuruman area, the *South African Mining and Engineering Journal* says:—The natives, themselves grossly ignorant of the rudiments of their occupation, attack the rock-bearing fibre, and burrow underneath the non-fibrous rock by tunnelling, until they reach a point where they bring themselves to a standstill, or else the unprotected open workings collapse and put a summary end to the work. In either case the particular portion of the mining area thus dealt with is no longer available for productive purposes; they then attack another portion of the fibre rock and carry on for a time. In no case is the face carried far into the hillside, and in consequence of this a number of otherwise good properties become valueless.

PROBABLY the most effective protection of wood against moisture changes is the aluminium leaf coating. This process simply incorporates a layer of aluminium leaf in the coating and provides a very strong barrier to moisture. The efficiency of this coating is about 98 per cent. It was developed particularly for use on aeroplane propellers, where very slight changes in moisture content are important. The process consists of applying a filler for open-grain woods, a coat of varnish for a foundation coat, and a coat of varnish which is used as a size. This size coat is allowed to dry until it is almost dust-free, when the leaf is applied over the surface, lapping the edges. It is smoothed down with cotton and a protective coating of spar varnish, enamel, or paint is usually applied over the surface.

RECENT specifications for tramcar equipment demand, according to *Nature*, a running speed of 25 to 30 miles an hour, which is practically double that demanded before the war. The length of the cars has greatly increased, and so also has their seating capacity. It is therefore necessary to use larger electric motors. It is usual to specify for two motors for each car, each being rated at from 50 to 60 horse-power. In pre-war tramway motors the armatures used to run at 600 revolutions per minute, whereas they now run at 900 revolutions per minute; also instead of being totally enclosed they are now self-ventilated. One important result of these changes is that the motors are both smaller and lighter, although they can exert nearly double the power. The design of tramway controllers has also been greatly improved.

IN concluding a paper read before the Cleveland Institution of Engineers, Dr. J. A. Roelofsen referred to the question of the cost of the Bergius process of treating coal. He remarked that as regards the cost of the products of the process, it was, of course, impossible for him to give really authentic figures, as they were very closely guarded, and, moreover, the large plants were only now under construction; but it had been stated that a ton of the finished products in the proportion in which they were obtained cost 92 marks—£4 12s.—after making due allowance for depreciation, &c. This compared with the present petroleum prices of 140 to 190 marks—£7 to £9 10s.—per ton of finished products, the difference depending on the amount of lubricating oil produced. Prices on the world's oil market would therefore have to fall 40 to 60 per cent. before the Bergius process ceased to be profitable.

Miscellanea.

THE Johannesburg Municipal Gasworks are to be extended at a cost of £300,000.

THE traffic through the Panama Canal was, last year, greater than that through the Suez, the tonnages being 26,836,000 and 26,060,000 respectively.

A COMPANY has, says *The Times*, been formed at Telaviv to run a regular transport service between Haifa and Baghdad. At first eight cars will be in use.

A SPECIAL ferry boat, driven by oil engines, is being built by Wm. Denny and Brothers for the Southern Railway, for the conveyance of motor cars across the Solent.

IT is suggested in the *S.A. Mining and Engineering Journal* that the Aiais district of South-West Africa may prove to be one of the important lead producing fields of the world.

A PAPER pulp mill with a capacity of 1000 tons a day is to be put up on the Campbell River, Vancouver Island. The first unit is to be completed within five years, and the ultimate cost will be £10,000,000.

WE learn that the contract for the building of the bridge over the Rhine between Cologne and Mulheim has been secured by Krupps. The bridge, designed by Professor Peter Behrens, will span the Rhine at one of its widest points without supports in the stream.

A COMMISSION has been set up by the Brazilian Government to study the conditions under which coal could be mined in the provinces of Parana, Santâ Catarina, and Rio Grande do Sul. The Federal Government had decided to develop the iron and steel industry of the country, for which purpose the solution of the coal problem is essential.

H.M. SENIOR TRADE COMMISSIONER at Calcutta has forwarded a copy of the report of the Indian Tariff Board regarding the continuance of protection to the steel industry. This report may be consulted by British firms interested on application to the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1.

THE use of electricity for heating, although a comparatively new development, has taken rapid strides in Strasbourg and the surrounding region. The consumption in electric heating in 1910 was only 16,676,551 kilowatt-hours. It has steadily increased, particularly since 1923. Between 1923 and 1925 the consumption rose over 100 per cent., the total in the latter year reaching 101,026,840 kilowatt-hours.

THE first section of the Serra Plant of the Sao Paulo Tramway, Light and Power Company has been started to work. This plant is built at the foot of Serra do Mar, 40 kiloms. from Sao Paulo and 15 kiloms. from Santos. The completion of this first section gives the company a hydro-electric generating capacity of over 200,000 horse-power. When the entire project has been completed there will be available an additional 250,000 horse power.

THE British Columbia Electric Railway, which has under construction a plant on the Bride River that will ultimately develop 60,000 horse-power, at a cost of 30,000,000 dollars, is reported to have decided to begin another plant of similar capacity, which will cost about 38,000,000 dollars. It is expected that the demand for electric power on the lower mainland of British Columbia will increase to such an extent within the next five years that construction on the new project will be necessary.

H.M. TRADE COMMISSIONER at Calcutta has forwarded a pamphlet, relating to specifications regarding oils and lubricants, as issued by the Chief Controller of Stores, India Stores Department, Delhi. It is suggested that by following the instructions contained therein British manufacturers should be able to avoid delay and misunderstanding in the supply of suitable materials as required by the India Stores Department. British firms interested may consult the pamphlet referred to on application to the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1.

AT the annual meeting of the Association of Professional Engineers of Ontario on January 25th, the principal question considered was a more satisfactory definition of the term "engineers" in the Acts of the legislature defining the types of work upon which professional engineers must be employed for the safety of the public. The matter is somewhat involved, as there are twelve such Acts, and a number of branches of the engineering profession are affected. It was pointed out that the legislation was not sufficiently explicit, that it was not stated what kind of an engineer must be employed. The matter of recommending to the legislature the amendments necessary to define the class of engineer required for the specified kind of work was left with the Executive Council.

A LARGE testing machine with a capacity of 400,000 lb. was installed in the electrical building of the University of Toronto on January 28th, a large number of engineers and prominent citizens being in attendance. This machine, which is by far the largest and most powerful of its kind in Canada, besides being used for the instruction of the students and research work, will be available for commercial tests, such as the testing of the strength of cables, bridge beams, &c. It is electrically driven by a motor beneath the floor, and it can be used for making tests by compression, tension or cross bending. The acquisition of this machine is much appreciated by the engineering profession, as there will no longer be need to go to the United States in order to obtain the use of testing machines of large capacity.

IT is reported by the National Federation of Iron and Steel Manufacturers that the number of furnaces in operation at the end of January was 152, 75 having resumed operations during the month and one having been damped down. At the end of April, 1926, there were 147 furnaces in blast and 144 at the end of January, 1926. Production of pig iron in January amounted to 434,600 tons, compared with 98,000 tons in December, 539,100 tons in April and 533,500 tons in January, 1926. The production included 142,500 tons of hematite, 154,100 tons of basic, 101,300 tons of foundry and 17,400 tons of forge pig iron. The production of steel ingots and castings in January amounted to 730,700 tons, compared with 319,300 tons in December, 661,000 tons in April and 640,400 tons in January, 1926.

BARTLEY RESERVOIR FOR THE BIRMINGHAM CORPORATION WATER WORKS

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(*For description see page* 182)

FIG. 7—GRAVEL LINING ON BASIN OF RESERVOIR

FIG. 8—CONCRETE PANEL LINING ON INNER SLOPE OF BANK

FIG. 9—FORMING CONCRETE PANELS ON INNER SLOPE OF BANK

FIG. 10—GENERAL VIEW OF WORK AT EMBANKMENT

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DEATH.

JANUARY 24th, at Sydney, N.S.W., ALFRED HANKINSON, aged 68, general manager of the Australian business of Richard Johnson, Clapham and Morris, Ltd., of Trafford Park, Manchester.

THE ENGINEER.

FEBRUARY 18, 1927.

President Coolidge on Naval Armaments.

IN a memorandum addressed to the Governments of Great Britain, France, Italy, and Japan, President Coolidge suggests that their delegates at the forthcoming meeting of the Preparatory Commission for the Disarmament Conference at Geneva shall be empowered "to negotiate and conclude at an early date an agreement further limiting naval armament, supplementing the Washington Treaty on that subject and covering the classes of vessels not covered by that Treaty." This communication was issued at Washington on February 10th, and on the same day the President, in a message to Congress, explained the motives which prompted his action. Dwelling upon the danger of competitive armaments, he implied that certain naval programmes now being proceeded with abroad were calculated to revive the spirit of competition. Even in the United States, as he acknowledged, a movement was afoot to promote further naval construction on the ground that other nations were building ships. The President made it clear that he did not believe in the immediate possibility of limiting all varieties of armament. If the negotiations at Geneva continued to be conducted on that basis he foresaw a deadlock, and most of those who followed the discussions of the Preparatory Commission last summer and autumn will be inclined to agree with him. He thought, therefore, that the United States "should make an immediate and sincere effort to solve the problem of naval limitation, the solution of which would do much to make the efforts towards more general limitation successful." Briefly, his plan is that the Washington Treaty, which at present covers only battleships and aircraft carriers, shall be extended to bring in every other type of combatant vessel, thus stabilising the relative strength of the leading navies in all the material elements of fighting power. Appreciating the possibility that France and Italy may hesitate to commit themselves to a system of naval restriction which the former, at least, decisively rejected at the Washington Conference, he proposes as an initial step the application of the five-five-three ratio to the non-capital tonnage of Great Britain, the United States, and Japan, leaving the ratios of France and Italy to be determined after further discussion. This proposal is really the crux of the Memorandum, which reveals, not only the sincere desire of the American President for a further measure of disarmament, but the long-cherished ambition of the American naval party to achieve absolute equality with Great Britain on the seas.

To treat the proposal as an altruistic gesture would be sheer affectation. While its acceptance might conceivably benefit other countries, the United States would stand to gain infinitely more than the rest, and we shall be doing the Washington authorities no injustice if we regard this motive as being partly responsible for their action. The present position is that the American Navy is equal to our own in capital ships, greatly superior in destroyers and submarines, and inferior only in cruisers. In proportion to the size of the battle fleet there is undoubtedly a marked shortage of cruising ships, only five of which have been laid down in as many years. The British Navy, on the other hand, has about sixty cruisers completed and building, a figure beside which the American total of fifteen ships may well seem insignificant. Yet upon analysis these figures are found to be somewhat misleading. The bulk of our existing cruiser tonnage—two-thirds of it, in fact—is already obsolescent. No less than forty-three of the British vessels were built between 1910 and 1917, when the standards of cruiser efficiency were much lower than they are to-day. Not only are these ships deficient in speed, but the great majority have a displacement of less than 5000 tons, which renders them unsuitable for oceanic operations. If they are retained on the active list it is only because there are not enough vessels of modern construction to take their place. The fifteen American ships built or provided for are all of post-war design. In addition, three others have been authorised for laying down when the first instalments are voted, and a Bill introduced to Congress in December, though not yet passed or even debated, provides for ten further cruisers. The British shipbuilding programme now in hand embraces twenty-one cruisers, to which must be added two Australian ships. These twenty-three ships, of which the last cannot be ready before 1932, represent the sum of cruiser tonnage provided for the British Empire since the Washington Conference. Moreover, they are the only efficient cruisers we shall possess in a few years' time, when most of the war-time and all the pre-war ships will have become unserviceable through age or stress of work. It is therefore very doubtful whether the British Government could agree to any abbreviation of a building programme which is manifestly based upon the absolute minimum of tonnage required for commerce protection. So vital to the life of this country and the existence of the Empire is the security of the trade routes, that we should be exceedingly ill-advised to enter into any engagement that might prejudice that security. Having in view the sole object of reducing their fleet and ours to a common standard of strength, American naval experts cannot be expected to make full allowance for the peculiar requirements of the British Empire in cruisers and other vessels essential for the protection of seaborne commerce. For this reason any ratios of non-capital tonnage suggested by Washington are likely to be inadequate from the British point of view. There is, in truth, no analogy between the naval necessities of Britain and America. Geographically and economically, their respective positions are poles asunder. If America aspires to complete naval parity it must obviously be for political reasons, not because she regards it as indispensable on the grounds of national defence. To the weapon of sea power no country is less vulnerable than the United States, none so vulnerable as this. Reverting to the broader terms of the American proposal, we are by no means satisfied that a tripartite naval agreement between Britain, the United States, and Japan is either desirable or practicable. To be truly effectual any further scheme of limitation should include every maritime State of importance; that is to say, the scope of the original Washington Treaty, so far from being restricted, should be extended. Already we see certain Powers that have no part in the Treaty preparing to develop their naval armaments on a fairly large scale. The underlying purpose of naval limitation is to stabilise the balance of power at sea; yet it is very evident that this purpose would not be achieved merely by imposing new restrictions on the expansion of the three leading navies. Having regard to the fact that of the 303 naval craft laid down since the Washington Conference, no less than 134 have been built in France and Italy, the futility of a new agreement from which those two States were excluded should be plain to all. While we are not among those who regard

continental submarine programmes as a direct menace to this country, we agree that they should and must be considered when estimating our future naval requirements. Judging from war experience, the submarine's most dreaded enemy is the destroyer, and if the destroyer is to employ its powers as an anti-submarine unit to the utmost it must be protected from interference by hostile surface craft. Such protection can only be afforded by the cruiser. There is in consequence a definite relation between our strength in these types of ships and our ability to resist future submarine aggression. Acceptance of the five-five-three ratio in non-capital types, as now proposed by the United States, would mean that we should have to keep our anti-submarine tonnage at a constant total even though the submarine flotillas of certain foreign Powers were steadily increasing. To put ourselves into such a position would be worse than foolish, yet it is difficult to see how it could be avoided if France and Italy were not parties to the projected naval covenant. It was the submarine question that prevented the full success of the Washington Conference, and nothing has happened in the interval to render this obstacle less formidable or more likely to be surmounted in the course of discussion.

We have no wish to magnify the difficulties of naval disarmament, but it is very necessary that the subject should be approached with a full appreciation of the problems involved. According to a Washington despatch to *The Times;* failure to reach an agreement on the lines indicated in the President's message may be followed by the introduction of a "very large" American naval programme. We trust, however, that this broad hint of moral suasion will not deflect the British Government from its plain duty of insisting upon an adequate measure of naval defence for the Empire. There is no doubt that the United States could, if it so wished, upset the whole balance of power at sea by investing even a fraction of its boundless wealth in warship construction. To do so, however, would be deliberately to encourage that spirit of rivalry in naval armaments which all the best minds in America are at one in condemning. We have sufficient faith in America's sincerity to believe that, even though her latest plan for the restriction of war fleets should prove unworkable, she will abstain from any action calculated to stultify the professions of peace and goodwill which adorn her President's latest message to the world.

Electrical Research.

WHILE the perpetual cry on the part of far-seeing people for more attention to electrical research may have become monotonous and boring to those who are not particularly interested in electrical affairs, the fact remains that those who persist in drawing attention to this matter are endeavouring to render a service to the community. When Mr. Ll. B. Atkinson became President of the British Electrical and Allied Industries' Association last year, he delivered an admirable presidential address, in which he showed that in engineering our inventors had lead the world. He also indicated that in the electrical field British engineers and scientists had done far more to stimulate progress than those belonging to other countries, and that, given adequate facilities for research, British brains and enterprise might easily replace the present squalid civilisation by a far better one.

At the luncheon which followed the Association's sixth annual general meeting on Friday of last week, the need for intensified electrical research was again emphasised by the new President, Mr. W. B. Woodhouse, by Dr. W. Eccles, and others. Great as progress has been in electrical engineering, no one imagines that the state of finality has been reached or that, given the necessary facilities for more research, new and important discoveries could not be made. Although, as Mr. Woodhouse remarked, the British Electrical and Allied Industries' Association Research Association has never been in a stronger position, it is not working on the scale it should be. In order to back up the inventive ability on which this country has thrived and prospered, its work must be extended. Notwithstanding that, translated into money value, the results obtained by the Association have vastly exceeded the expenditure, Government help is gradually being withdrawn, because it is felt that in future the Association should be supported by the industry. During the war, when the need for all kinds of scientific investigation was felt, every encouragement was given to research, with the result that great progress was made in many branches of science and engineering. Nevertheless, at the close of the war the lesson that technical research is essential to the welfare of this country had not apparently been learnt by those who govern, and the question of cutting down expenditure in that direction began to be discussed. Considering, however, how much the world's industrial development along the most varied paths has been indebted to individual British research, it should be clear to everyone that in these days, above all times, research should receive hearty recognition. In the words of Dr. Eccles, this country has been most fertile in ideas, although sometimes slow in working them out. It had happened, he said, that a discovery had been exported, worked out abroad, and then we had had to pay those who worked it out to sell us the goods, and that had happened because in this country there was little co-operation between the men of pure science and of applied science. An endeavour most certainly ought to be made to form some working liaison between those two classes of men, and research should be given every encouragement. There is no question that we still have in this country excellent inventive brains, which, with the aid of adequate facilities for investigation, will always maintain the lead in engineering and scientific matters that this country has held. That in certain directions, as, for example, in the manufacture of high-pressure cables, other countries may be getting ahead of us, may be true, but in spite of everything, in the way of epoch-making inventions we still hold our own. The beam system of wireless communication and television are two recent examples of British ingenuity and enterprise.

Although the financial support which the British Electrical and Allied Industries' Association receives is now adequate to meet the bare requirements of the minimum scale of working, in order to keep the work within the limitations of the income it has been necessary to defer many promising programmes indefinitely, and in view of the diminishing scale of contributions made by the Department of Scientific and Industrial Research, it is recognised that efforts to increase the Association's income must be actively continued if the present restricted scale of operations is to be maintained. As the sixth annual report of the Association shows, some very important and useful work was carried out during the past twelve months, but those in a position to judge the capabilities of the Association, firmly believe that if greater financial resources were available the electrical industry might very easily benefit to a far greater extent than it has done in the past.

Engineering Wages: Their Influence on Manufacturing Costs.

By P. T. WILKINS.

MUCH has been written around the question of wages, more especially during the post-war years, and chiefly viewing it from the employer's standpoint. It has been said that the wages paid in the engineering industry, compared with the output given by the men, has placed the employer in a position from which he cannot quote competitive prices against foreign competition. We have been told that the continental workman works longer hours, turns out more per man, and for less per hour than our own workmen. This is all probably true, but the writer, after twenty-six years' experience in the engineering trade, thirteen of which were spent in the shops, and thirteen in positions covering shop control, rate-fixing, estimating, planning and costing, is of the opinion that any shortcomings on the part of the men have been caused by the policy adopted by the employers themselves, or, in a greater degree still, by the men holding supervisory or executive positions under the employer.

The sin of the employers has been in the main that of omission rather than commission, in that they have not been in close touch with the relations existing between the workmen and those responsible for manufacturing costs. It is obvious that in any concern where the different departments are under separate chiefs, who are responsible for the work done by the department and its staff, the details of that work cannot be known by the employer or managing director, as the case may be, and yet it is the detail work of a department—the rate-fixing—which determines the man's wages, and it is here that a great percentage of the causes of dissension arise. The man is out for a good price—to his idea—and the rate-fixer is out for a keen one—to his. Human nature being as it is, the first is a plus figure, and the latter a minus. Finally a price is agreed upon, and the man sets out to produce according to the conditions in his particular shop. If he has found by experience that any exceptional effort or skill on his part is rewarded by a good percentage balance, which he is encouraged to earn by the executive, and allowed to enjoy with no fear that the price will be reduced, ca' canny has no place in his scheme of things. If his experience proves that by letting out all his links and earning a good balance, he is inviting a cut in price, sometimes justified by the department concerned as a "change of method," which is often but a poor peg to hang it on, he works to the price (secured, usually, after a keen fight over the before mentioned plus and minus quantity) and puts in just the balance which is considered by his executive as looking about right. And this is where the employer finds his complaint *re* heavy manufacturing costs, because wages paid on a job are, in the majority of cases, used as a base for the overhead charges against that job. It is rarely that overhead charges are apportioned out to the individual machine, the more general practice being to use a predetermined percentage on labour costs.

Now it should be obvious that high wages, earned by effort and skill off a carefully estimated price, reduce costs, and do not increase them. If £1000 wages per week has produced ten machines, and £1500 is the overhead charge per week on the factory, then the labour and charge cost per machine is £250. If the men are encouraged to go their limit, and as a result twelve machines are produced (the overheads remaining practically constant) the same cost is reduced to £225, which does not uphold the oft-quoted statement that it is the wage question which determines competitive selling price. This has been proved by the high wages paid in America, whose manufacturers can and have out-quoted our products in this country.

All the foregoing, of course, relates to piecework, or any other system of payment by results. What of the man whose job is not a repetition one, and who cannot be paid on any such system? Tool-room hands, millwrights, and inspection staff are the men who are mostly paid by hour rate, and mostly underpaid when compared with pieceworkers, when we consider that such men are, in the majority of cases, the truly "skilled" men. It has been the writer's experience to see semi-skilled pieceworkers whose hour rate is 10d., earning consistently a 50 per cent. to 60 per cent. balance, and using tools made by men whose hour rate is 1s. 1d. or 1s. 2d., with no reward for any extra effort put in on rush jobs, such as machine or tool breakdowns, of which a surprising number turn up in any plant. These are the men who have a definite and genuine kick against the conditions which exist in the engineering trade regarding wages; they know their work is "key" work, and they know that their pay is less than that of the unskilled or semi-skilled pieceworker, either actually or comparatively—in most cases actually. So the tendency is to "go slow," and what more natural? All they have to sell is their labour, and if the price paid is poor, they give what they consider is value for that price, which is not the limit of their capacity. There are some shops that run tool-room hands and millwrights on piecework, but the nature of the work precludes any possibility of such systems being "straight." Take the case of a jig, composed of a number of parts, necessitating shaping, boring, drilling, turning, hardening, grinding, &c.; it must pass through numerous hands, making it impossible for every operation to have a price offered and accepted before the job is started. The rate-fixer estimates, say, sixty hours for the job as a bonus time (and it must be borne in mind that he is a man selected for his abilities in that direction, or should be) the man thinks he might make something out of eighty hours; the job must be done before one or other is proved right—or both wrong, which has happened. But if the job takes sixty hours, and the rate-fixer still says sixty should have been enough to earn a balance, and refuses to pay more, the man thinks he is being exploited. If he pays eighty hours, which will give time plus one-third, the employer is paying that much extra hourly rate, and has no guarantee that any effort has earned it. Would it not be better to increase the hourly rate of rate-fixers permanently, which would give them a status above the ordinary machine hand, and save the overhead cost of staff necessary to pay by any piecework or bonus system?

Inspectors are in worse case, for only once has the writer run up against any attempt to pay them piecework, and while it looked well on paper, in practice it proved open to misuse, almost impossible to check. Admittedly some inspection work is elementary, and can be done efficiently by cheap unskilled labour, but there is the other kind that does require a skilled man, who must have sound common sense and use it, unless the concern is to lose the value of pieces varying slightly from drawing limits but still usable. And his responsibility is greater where the drawing-office does not give limits; he must know the function of all the pieces, and use his knowledge gained by experience when passing or rejecting. He, too, feels that things are unjust when his wages work out at less than those of the pieceworker whose work he is passing.

Unfortunately the men, as represented by the trade union officials, do not look at the position from the correct standpoint, or their recent demand for an

all-round increase of £1 per week would not have been made. The pieceworker, while he would not turn down the £1 if it came along, does not expect it, and in the majority of cases is quite happy without it. But the daywork man would be getting no more than a fair wage if he was awarded the £1 increase, and there is a great probability that the demand would have received more consideration from the employers had it been made for day workers only. Obviously, as long as the demand is made an all-round one, the employers can quote average wages paid in districts, which look all right on paper; but the average daywork wage paid in any district, excluding overtime, would make a poor show.

This unrest of the skilled man is affecting the manufacturer in a direction which will be more acutely felt when the older generation passes out, as boys are being trained in decreasing numbers for these jobs. The shortage is already being felt keenly in America, and that shortage, coupled with the wages Americans are prepared to pay to skilled men going over from this side, must inevitably leave our manufacturers in a bad position from which to compete.

Summing up this question of wages it would appear that the employer could gain by shifting his standpoint. Tradition dies hard, and when it is remembered that this country led the world in the engineering industry, it may be that our traditions are out of date. We supplied the world with teachers, and those teachers, being the most pushing and receptive of those taught, started their pupils further ahead than they themselves were started. This fact, coupled with natural aptitude and resources, has given some of our competitors a lead, which can be regained by a fresh line of thought being taken. That line must be to get the confidence of all men engaged in the industry, or rather, all those that matter; there will always be a small minority of men sore under any conditions, but the majority will take care of *them*. This getting of confidence has been the subject of many conferences between representative employers and workers' unions, but any good they may have done is undone in many individual concerns by some hack rate-fixer or foreman, who is out to make his side look well from what he considers should be his employer's point of view. During the war years it was agreed that a price once fixed would not be reduced, no matter what the earnings, but that agreement is no longer carried out unanimously; the quantity of labour available during the lean years making it possible to get men under almost any conditions, and the agreement has been violated in many cases.

This does not make for that understanding which will give world supremacy; it is a desolation called a peace, and so surely as prosperity returns, so surely will the old struggle begin again. Everyone engaged in the struggle will lose, and those outside the dispute will feel the effects. The great majority of workmen are level headed, sensible folk, who readily respond to a friendly move, and have no use for the wild men who are out to destroy existing conditions with nothing to put in their place. Let them see that they are to be encouraged to earn all they can off prices fair to the manufacturer, and let the employer see that the man or men he engages to set those prices and cost-up from them, are up to their job, and have the correct psychology for it. Make conditions so that daywork men, whose job will not permit of any straight payment by results, do not have cause to feel unjustly treated on pay day, and a long step will have been taken towards that peace in the industry which will get production on a scale giving our manufacturers a leading place in world trade.

Obituary.

SIR GEORGE GREENHILL.

A GREAT mathematician has been removed from our midst by the death of Sir George Greenhill, which took place at his brother's house in Penge on Thursday of last week. His death was really the outcome of an accident which he sustained when alighting from an omnibus just before Christmas, and from which he never really recovered.

Alfred George Greenhill, who was the third son of the late Thomas Greenhill, was born on November 29th, 1847, and he had therefore entered well into his eightieth year at the time of his death. He was educated as a Bluecoat Boy at Christ's Hospital, where he very early showed his bent for mathematics, winning, amongst other distinctions, the Thompson Mathematical Gold Medal. From school he went to St. John's College, Cambridge, to begin a career of unusual brilliancy. He was just beaten for first place in the Mathematical Tripos, but he tied with the Senior Wrangler, who had beaten him in that, for the coveted distinction of Smith's Prizeman. There are those who say that to be Smith's Prizeman is a greater evidence of ability than to head the Tripos list. As a result of this achievement, he was made a Fellow of his College. It should be added that prior to taking his degree, he was Pitt Club Exhibitioner, Somerset Exhibitioner, London University Scholar, and Whitworth Engineering Scholar, and in this connection we may remark in passing that had he not been the pre-eminent mathematician that he was, he would in all probability have been a great engineer. At any rate, he had the somewhat rare ability of applying his mathematical knowledge to practical uses, especially in dynamics and in engineering matters.

Greenhill did not stay long at Cambridge, in the first instance, for he was made almost at once Professor of Applied Mathematics at the newly founded college at Coopers Hill. There he remained for two or three years, and on the whole spent a very happy time, judging by what he said of it in after life. Everything was, however, not exactly to his liking, and all through his life, if he did not like doing a thing, he resolutely refused to do it. So when, in 1873, he received an invitation from Emanuel College, Cambridge, to become a Fellow and take up the position of Mathematical Lecturer there, he accepted. He was, then, it will be realised, under twenty-six years of age, yet, in addition to his lecturership, he was also one of the examiners for the Mathematical Tripos.

Greenhill's life's work was, however, his professorship at the Royal Artillery College at Woolwich. It would be hard to put too high a value on his labours in that position. Generation after generation of artillery officers passed through his hands, and were instructed in theoretical gunnery. In that branch of science he became an expert with literally no rival. He was among the foremost authorities on ballistics of his time, if, indeed, he was not, himself, at the head of all. And while he was continually teaching the practical application of mathematics, he was concurrently delighting in the study of it from the purely theoretical standpoint. He was particularly interested in elliptic functions, but his investigations took him over a wide field, which included hydrostatics, mechanical flight, the motor car, the steam turbine and the gyroscope. He was a prolific writer on a diversity of subjects, and we frequently had the pleasure of publishing contributions from his pen. A peculiarity of his "copy" was that it was written on sheets of paper of enormous size, and nearly always in pencil.

Sir George received his knighthood in 1908. He was a Fellow of the Royal Society, a corresponding member of the French Academy of Sciences, a foreign member of the Accademia dei Lincei at Rome, and an Associate Member of the Ordnance Committee.

Whilst all admired his wonderful ability as a mathematician, to his friends he was endeared rather by his eccentricities than by his learning. He was, it must be admitted, with affection not reproach, extraordinarily untidy, both personally and in his surroundings. He lived in Staple Inn, one of those quiet little backwaters of London where disorder is a fitting memorial of the past. We can almost picture Dickens or Besant using his room, and him, too, for that matter, as a model. Around the walls were strung pendulums and a few portraits; on the floor an ancient carpet that he brought with him from Cambridge; whilst all about in more or less confusion lay books and papers. Thence, he issued, in the latter days at least, in an old top coat, flapping loosely about him, a muffler wrapped untidily around his neck, to seek the respectability of the Athenæum, the sedate learning of the Royal Society, or to attend a meeting of the Newcomen Society, where he could revel in the history of men he had known in his youth. There, in his old age, he slumbered quietly—respected by all. His eccentricity carried him to the point of bluntness and sometimes what to the unitiated seemed rudeness. He would stop suddenly in the middle of a walk, strike his stick upon the ground, and "in good set terms" sort anyone, man or woman, who had trespassed on one of his idiosyncrasies. It cannot be said that he "suffered fools gladly." He did nothing of the kind. They were anathema to him, and he was never more deeply stirred than when he saw ineptitude in high places. With all his academic learning, he was, in fact, essentially practical. For example, we may recall that during the war he donned khaki and was proud of the fact that he was a "private" in a Territorial regiment. It was the application of science that appealed to him, and many a time in the street, as often as in the office, we have been held up whilst he declaimed against the lassitude of authority—generally military. Amongst his peculiarities was his bedtime. At one period he made it a rule to spend twelve hours out of the twenty-four in his bed. Not necessarily to sleep, but to read, to think, to work, even to write. Then it was that his manuscript came to us on sheets of paper about 18in. square, scrawled upon in a large hand. It is supposed that they had been written in bed. Only under heavy persuasion could he be induced to produce "copy" more convenient for compositors. In late years his attentiveness, if not his memory, began to weaken, and those who went with the British Association to Canada a few years ago will remember how he was "lost," just as he was a year or two later at the Norwich meeting of the Newcomen Society. Everyone who knew him has little stories about him, and as they recall them to each other, sitting round the club fire, it is generally with exclamations of Dear Old Greenhill as a *leit motif*, and with all his little asperities and peculiarities become bonds of affectionate remembrance.

Literature.

SHORT NOTICES.

Die Auskleidung von Druckstollen und Druckschachten. By Dr.-Ing. Otto Walch. Berlin: Julius Springer. 1926. Price, unbound 19·50 marks, bound 21 marks.—In this well-illustrated book of 182 pages, the author, an engineer of the Siemens-Bauunion has gathered together interesting material concerning the lining of pressure tunnels and shafts. After briefly considering the effect of earth and water pressures, water flow and weight of lining, some physical characteristics of rock formations are discussed in relation to their influence on the making and lining of pressure tunnels. The determination of tunnel pressures and movements is dealt with theoretically and experimentally, and examples of actual tests are given. In the main part of the book over eighty examples of pressure tunnels and shafts, mostly constructed on the Continent and in America, are referred to, the principal features of many of them being illustrated. The Torkret and Moser systems of concrete spraying under pressure are described, and instances of the application of such methods are given. Other types of tunnel linings dealt with include those in which artificial stone, reinforced concrete and steel and wood are made use of, while the construction of containers for the storage of compressed air is briefly considered. The book closes with a bibliography of the subject, and a list of installations which have already been carried out. A valuable appendix is given in the form of five tables, with full particulars of eighty-six pressure tunnels and shafts which have been constructed.

Capacities and Properties of Steel Tubes.—A publication which we have received from Stewarts and Lloyds, of Glasgow, deserves to be classed above the usual run of trade publications and ranks rather with engineering books of reference. Above all it includes practically no advertising matter, so that the recipient is not tempted to destroy its binding with the object of eliminating unwished-for pages. All the material in the book is in tabular form and gives the discharge capacities of water and gas mains and steam pipes under a wide variety of conditions, the moments of inertia and the moduli of tubular sections, the bursting and collapsing pressures of pipes and much other information, such as the strength of tubular spans, derricks, and so forth. The publication is admirably printed and the information is given in a very convenient form for reference.

Electric Trains. By R. E. Dickinson. London: Edward Arnold and Co. Price 16s. net.—This book is primarily intended for railway engineers and it deals with the fundamental principles of electric traction, with apparatus and devices in use and with some convenient methods of making practical calculations. The scope of the volume is indicated by its title, questions of generation, transmission and transformation of electric power having been entirely omitted. There are chapters on the mechanics of train movement, series parallel control, control systems, rheostat calculations, direct-current traction motors, current collection, single-phase railways, three-phase and slit-phase railways, brakes, train resistance, direct-current motor performance and rating, regeneration, and complete calculations for an electric train.

BOOKS RECEIVED.

Jahrbuch der Schiffbautechnischen Gesellschaft. Vol. 28. 1927. Berlin: Julius Springer, Linkstrasse 33–34, W. 9.

The New Electricity Act. By W. S. Kennedy. London: Ernest Benn, Ltd., 154, Fleet-street, E.C. 4. Price 6s. net.

Drainage and Sanitation. Third Edition. By E. H. Blake. London: B. T. Batsford, Ltd., 94, High Holborn, W.C. 1. Price 15s. net.

Carnegie Scholarship Memoirs. Vol. XV. Edited by G. C. Lloyd. London: The Iron and Steel Institute, 28, Victoria-street, S.W. 1.

Aerial Cableways. By G. Beretti. Translated by W. J. Walker. London: E. and F. N. Spon, Ltd., 57, Haymarket, S.W. 1. Price 5s. net.

The Journal of the Iron and Steel Institute. Vol. CXIV. Edited by G. C. Lloyd. London: The Iron and Steel Institute, 28, Victoria-street, S.W. 1.

Rotary Converters Their Principles, Construction and Operation. By E. P. Hill. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 25s. net.

The Directory of Shipowners, Shipbuilders and Marine Engineers, 1927. London: The Directory Publishing Company, Ltd., 33, Tothill-street, S.W. 1. Price 20s. net.

Annales des Ponts et Chaussées. 1926. No. VI. Novembre-Décembre:—(1) *Partie Technique;* (2) *Partie Administrative.* Paris, 9e, A. Dumas, 6, Rue de la Chaussée-d'Antin.

The Support of Underground Workings in the East Midland Coalfield. Safety in Mines Research Paper No. 30. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2d. net.

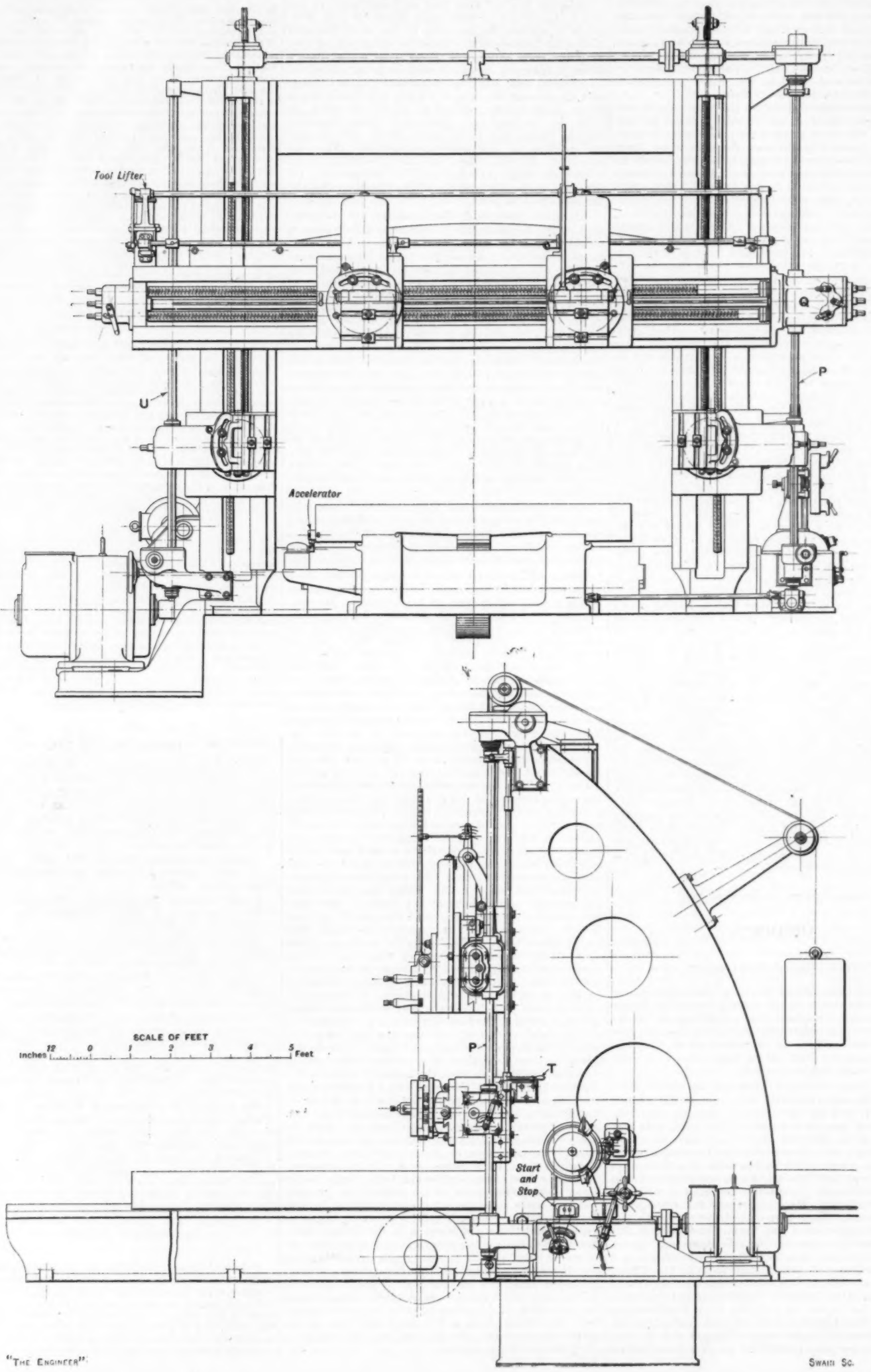
Collected Papers of Sir James Dewar. Two volumes. Edited by Lady Dewar, assisted by J. D. Hamilton Dickson, H. Munro Ross and E. C. Scott Dickson. London: The Cambridge University Press, Fetter-lane, E.C. 4. Price 84s. net.

PULP and paper production has moved into the front rank of Canada's industries. Canadian mills during 1926 working at 96·9 per cent. of rated capacity, turned out 1,881,737 tons of newsprint—about 200,000 tons in excess of the U.S.A. figure. Additional mills will be in operation this year, and it is estimated that at the end of twelve months the daily production capacity of newsprint will reach 8500 tons, as against 7300 tons at the close of 1926.

ELECTRICALLY-DRIVEN "HILOPLANE" PLANING MACHINE

JOHN STIRK AND SONS, LTD., HALIFAX, ENGINEERS

(*For description see opposite page*)



"THE ENGINEER".

SWAIN SC.

A Large Electrically-driven Planing Machine.

ALTHOUGH it is some twelve years since the "Hiloplane" design of planing machine was introduced by John Stirk and Sons, Ltd., of Halifax, we willingly accepted a recent invitation from the firm to visit its works for the purpose of inspecting and handling for ourselves a very large example of the design just before it was dispatched to its purchasers, Ruston and Hornsby, Ltd., of Lincoln. The example inspected is of interest because it embodies Messrs. Stirk's latest practice, and because its great size—it weighs 75 tons and can plane the faces of a block 10ft. wide, 8ft. high and 20ft. long—makes it readily possible to test thoroughly the claims of the makers concerning the ease of adjustment and operation attending the adoption of their system of electrical drive.

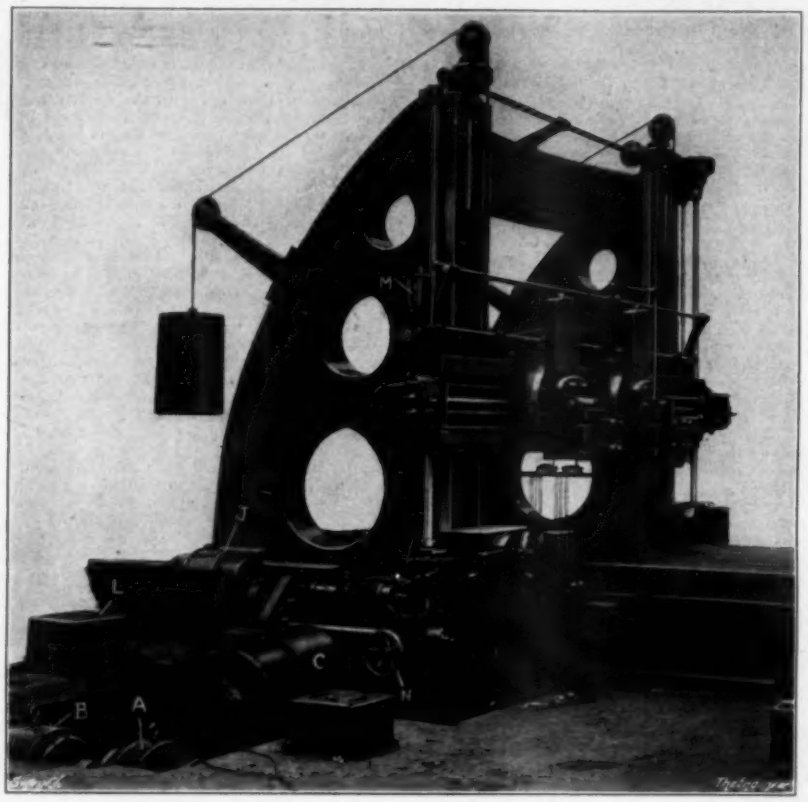


FIG. 1—DRIVING SIDE OF "HILOPLANE" MACHINE

The machine, like all others of the "Hiloplane" design, is characterised by its electrical drive and the universality of its movements. The simple planing machine of the ordinary type can machine the top horizontal surface of a work slab, and if fitted with side tool heads can operate on the two vertical side faces. In both these cases the cutting motion is in the longitudinal direction, while the feed motion in one case is in the transverse and in the other in the vertical direction. The "Hiloplane" can perform both these operations. In addition, it can convert its cutting motions into feeds and its feeds into cutting motions. The result of such a change in the one case is a transverse cutting motion on the top horizontal face of the work slab, and in the other a vertical cutting motion on the sides. The first modification may be further modified. With the cutting motion maintained in the transverse direction, the feed may be changed from horizontal to vertical, with the result that the end of the work slab nearest the uprights may be planed transversely. It is possible in this setting once again to interchange the feeding and cutting motion, with the result that the end of the slab can be planed with a vertical cutting motion and a transverse horizontal feed. Finally, the work may be run through between the uprights and with the relief movement of the cross slide tool heads suppressed, the outer end of the slab may be planed transversely, or vertically. In this way all the faces of the slab, except that resting on the table may at one setting be planed in either of their two directions. It is, moreover, quite practicable to combine the cutting of the side heads with the cutting of the cross slide heads. By so doing the top face and the two vertical side surfaces of the slab may be simultaneously machined with longitudinal cuts—as is possible in an ordinary machine with side heads, if it possesses sufficient power. Alternatively, the top face may be planed transversely at the same time as the sides are being planed vertically.

We have spoken of the work as a rectangular slab. It will be understood that we have done so simply because such a body may be taken as a general representation of the work submitted to the machine. In actual practice, were the work to consist of nothing but rectangular slabs the machine, as compared with an ordinary planer fitted with side heads, would be found to possess considerable redundancy. Its capability of planing the top surface transversely and the sides vertically would, for instance, be superfluous. In actual use, however, the general run of work will have various flanges, faces, slots and so forth, which will restrict the choice of direction in which the work is to be planed or demand a cut which one, and one only, of the various different movements is capable of giving. As an extreme example, illustrating in reality other features of the machine besides those which we have so far mentioned, we may say that with a narrow tool and a broad feed—or, in general, a feed greater than the width of the tool—it is possible to plane a rack from the solid on the top or either of the side faces of the characteristic work slab. We have seen this operation performed. After each space between the rack teeth has been traversed once the tool is returned by a power movement to the first space. Hand feed depthwise is applied, and the second set of cuts is taken. With each successive set the depth of the spaces is increased, but their widths remain inappreciably different from the width of the tool. This fact illustrates another feature of the machine, namely, the accuracy with which the cutting tools are returned to any given initial position.

It is not our intention to describe the construction and operation of the numerous mechanical and electrical details composing the operative parts of the machine. Circumstances and the space at our disposal preclude our doing much more than describing it as it appears on external inspection.

The machine is driven on what is known as the Stirk patented split field system, a modification of the well-known Ward-Leonard drive. In the photograph of the driving side—reproduced in Fig. 1—A is the primary motor taking either direct or alternating current from the mains, and driving a special generator B. By manipulation of the magnetic field of this generator, current at variable voltage and alternative polarity can be produced. The variation of the generator voltage varies the speed of the main driving motor C, and the change of polarity reverses its direction of rotation. The shunt field windings of the generator B and the motor C are divided into two sections. In the generator these sections are connected to oppose each other with the result that the alternative excitation of the sections gives alternative polarity. The two sections of the motor field, on the other hand, are connected in agreement. One of them is lighter than the other, and is permanently excited. The heavy section is excited only during the cutting stroke. The increase in the field strength when both sections are excited gives the slow speed required for cutting, and the decrease during the other portion of the cycle gives the required quick return speed.

The cycle is controlled by means of a disc D and master switch E—Fig. 2—and by two contactors contained in the control panel shown in Fig. 3. The disc D is geared to the table in a ratio which causes it to turn through about 360 deg., while the table is making one full stroke. Two adjustable dogs are clamped in a groove on the face of the disc, and may be set at various angular distances apart against an engraved scale. The dogs operate the master switch, which, in turn, operates the contactors in the control panel—Fig. 3—with the result that the polarity of the current supplied to the driving motor C is changed and the direction of travel of the table reversed. The further the dogs are set apart, the longer will be the stroke of the table, and if they are both moved in the same direction, the position of the stroke will be varied. The dogs may be adjusted to reduce the stroke down to as small an amount as 3½in. in the machine inspected.

The panel illustrated in Fig. 3 is equipped with two shunt regulators F G, whereby the generator voltage may be varied and the cutting and return speeds of the table may be controlled independently of each other. The third hand wheel H enables the driving power supplied to the machine to be increased or diminished.

In addition to these electrical means of changing the table speed, a two-speed mechanical gear change operated from the hand wheel N—Fig. 1—is provided between the motor C and the rack-and-wheel drive to the table. On the high gear the electrical equipment permits the cutting speed to be varied over the range from 20ft. to 80ft. per minute, and the return speed independently over the range from 90ft. to 150ft. per minute. On the low gear the ranges are respectively 10ft. to 40ft. and 45ft. to 75ft. per minute. The provision of this high and low mechanical gear change explains the origin of the name "Hiloplane" applied to the design.

The table rack, it may be noticed in passing, is cut from a solid forged slab of steel and the large wheel meshing with it—see the general arrangement drawing reproduced on page 190—is formed of a weldless steel ring shrunk on to a cast iron centre. The two-speed change gearing is distinguished by the fact that after the motor pinion no key is employed in any of its wheels.

Having outlined the manner in which the table is reciprocated during longitudinal planing, we will now turn to the means employed for the application of the cross feed to the tool-boxes during such planing. This feed is

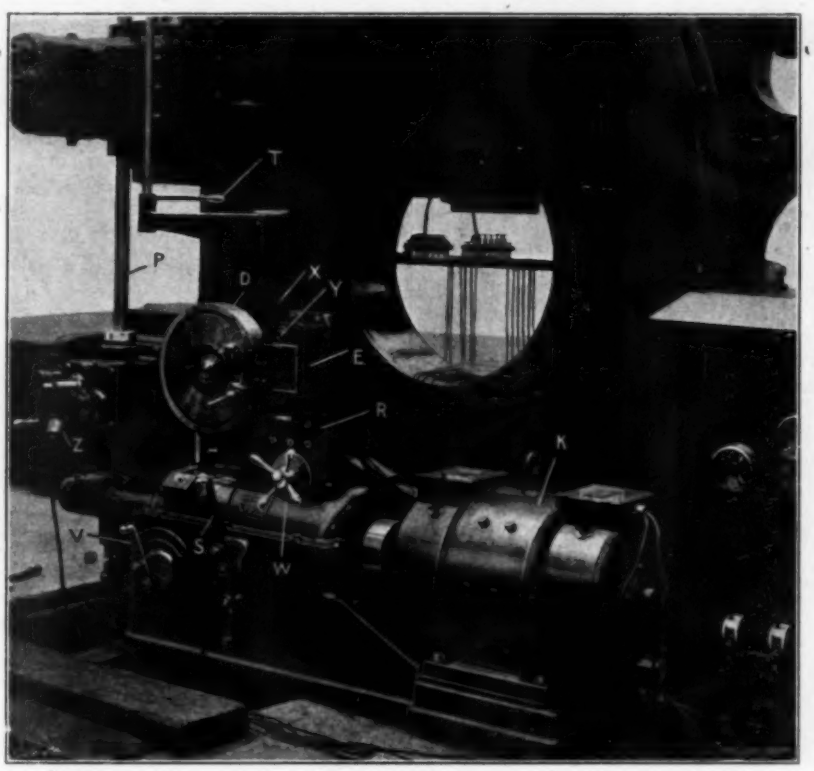


FIG. 2—CONTROLLING EQUIPMENT

applied electrically at the end of the return stroke by the supplementary motor shown at K, Fig. 2. Power is transmitted from this motor through a gear-box in line with it and through mitre wheels on to a vertical spline shaft P. Through selector gearing—shown at Q in the general arrangement drawing on page 190—the power is passed to two screwed shafts, one for each tool head, on the cross

slide. By means of the levers at Q either or both of the screwed shafts may be coupled to the shaft P. In addition, the gearing controlled by the levers Q is such that while the lower screwed shaft can be directly connected to P or disconnected from it, the upper screwed shaft may be connected to P, either directly or through reverse gearing. Finally, the setting of a small tumbler switch on the box R, Fig. 2, determines the direction of rotation of the motor K, and consequently of the shaft P. These details permit the tool heads to be fed across the work at any set distance apart, either from left to right or from right to left, or permit them to be fed either towards each other or away from each other. In addition, either head may be thrown idle while the other is fed in either direction.

The motor K for the purpose of feeding the tool heads crosswise is caused at the end of the return stroke of the

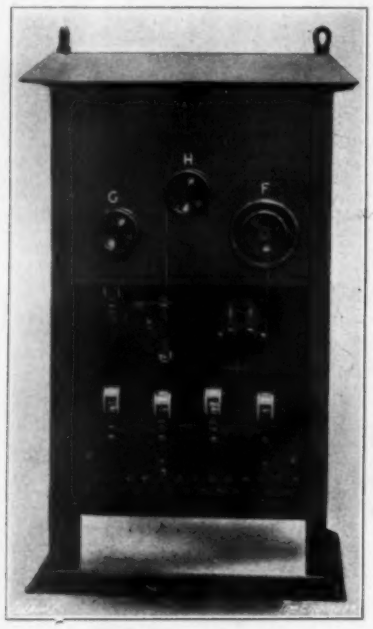


FIG. 3—CONTROL PANEL

table to make either an exact half turn or an exact full turn, the selection being under the control of a tumbler switch on the box R, Fig. 2. Just in front of the box R a disc W, with a star handle, indicates the setting of the wheels in the gear-box through which the motor K transmits its power. This disc has three positions, which correspond with feeds of $^1/_{32}$in., $^3/_{32}$in. and $\frac{1}{8}$in. per stroke when the motor K is set to make half a turn at each cycle and with feeds of $\frac{1}{16}$in., $\frac{1}{4}$in. and $\frac{1}{2}$in. when the motor is set to make a full turn. In addition to these stock-removing feeds, two broad finishing feeds of $\frac{1}{2}$in.—half turn—and $1\frac{1}{2}$in.—full turn—are obtainable by throwing the lever S, Fig. 2, over from the right to the left.

The actual application of the feed movement occurs during the interval in which the tool overruns the work at the end of the return stroke. In some designs of planing machine the extent of the over-run, which represents a waste of motion and time in all cases, has to be made considerable in order to afford the necessary opportunity for the feed movement to take place. In Messrs. Stirk's machine the application of the feed is as nearly instantaneous as it could be, with the result that the over-run can be kept down to a wonderfully small amount. It was demonstrated to us that with a feed of $^3/_{32}$in. it was unnecessary to have an over-run of more than $\frac{1}{4}$in., and that the broadest finishing feed of $1\frac{1}{2}$in. could be applied during an over-run of $\frac{1}{2}$in. It should be noted that the setting of the stroke and the adjustment of the over-runs at both ends of the work are very readily controlled by means of the dogs on the disc D.

One or two other points connected with the operation of the machine for longitudinal planing deserve brief mention. The starting and stopping of the table motion is controlled from two sets of push buttons, one on each side of the machine. In addition, an inching button—Y, Fig. 2—is arranged on the casing of the master switch E. The feed is started and stopped by means of a tumbler switch on the box R. An accelerating switch on the driving side of the bed operated by adjustable dogs attached to the edge of the table can be set to increase the speed of the table at any desired point of the cutting stroke, as, for example, while the tool is passing across a gap between two faces. On the return stroke of the table the tools, particularly if they are of the broad finishing type, are not allowed to trail over the surface of the work, but are lifted clear of it by the action of a solenoid M, Fig. 1, which is automatically energised during the return stroke. This solenoid is linked to a lever on a horizontal shaft carried on top of the cross slide. The shaft, in turn, is connected by a lever and chain to a rod extending vertically upwards from the clapper of the tool head. As this tool-lifting device is not required in certain settings of the machine, a switch is provided on the box R, Fig. 2, to cut it out of action. Below and parallel with the tool lifter shaft on the cross slide, there is a second shaft which carries adjustable stops which automatically cut off the feed motion of the tool heads at any desired point in either direction. In addition, limiting switches at the outer ends of the cross slide stop the outward movement of the heads before damage can be done, while a buffer switch between the heads prevents them from colliding when their movements are convergent. After any of these trips have acted they can be immediately re-set by means of a "come-back" switch X, mounted close to the master switch E, Fig. 2.

The cross feed motions applied to the tool heads by the motor K can readily be changed to corresponding power traverses by increasing the speed of the motor K, and cutting out the contactors which, for feeding purposes, cause that motor to stop at the end of every half or whole revolution. The required change in the electrical connections is effected by the operation of a double-pole tumbler switch on the box R. The rest of the gear between the motor and the shaft P is not affected by this change, and, as a consequence, a series of fine and quick power traverses is available by means of the feed disc W and the lever S. These power traverses can be started, stopped and reversed by the manipulation of the two tumbler switches provided on the box B to effect the corresponding control over the feed motion. To facilitate the setting of the tool heads from a point at which they are clearly in view, a long flexible lead is run from the box R to a double push button pendant switch Z, whereby the traverse can be started, stopped and reversed at will.

The power traverse applied in the above-described manner to the tool heads may by a simple change be transferred from the heads to the cross slide as a whole for the purpose of elevating or lowering it. To effect the change the selector levers at Q—see page 190—are put into the neutral position and the handle T is turned to clutch the vertical shaft P to a shaft extending across the tops of the columns and driving down on to vertical screwed shafts lying between the shear faces. Since the vertical movement of the cross slide is intended principally for adjustment purposes, it is not thought necessary to counterbalance the slide. The balance weights shown in the illustrations are attached to the side heads. It will be clear from what we have said regarding the power traverse applied to the cross slide tool heads, that the power traverse applied to the cross slide can be made at various speeds, and that the movement is under the control of the pendant switch.

To take longitudinal cuts along the edges of the work slab by means of the side heads, the controls at Q and the handle T are placed in the disengaged position. The shaft P, it will be noticed, is embraced by the right-hand side head. It may be clutched to the head and caused to operate a nut rotating round a fixed screw lying between the shears of the column. A shaft U corresponding to P is embraced by the left-hand side head. The movement of P is transmitted to U by way of a spline shaft lying between the two horizontal screws of the cross slide, the driving connection being established by means of the centre control lever at Q, and a corresponding lever at the other end of the cross slide. The full range of the feeds and power traverses given by the equipment shown in Fig. 2 can in this way be applied to cause vertical movement of the side heads separately or together. Horizontal inward feed of the side tools is applied by hand. The side heads are mounted to swivel in order that inclined faces may be planed. In this case the feed is applied wholly by hand. By the manipulation of the levers at Q, it is quite possible to bring both side heads and both the heads on the cross slide into action simultaneously or in any desired combination.

There still remains to explain the manner in which the machine is caused to take a horizontal cut across the top face of the work, a vertical cut down the end, a vertical cut down the side, and a horizontal cut across the end. Let us consider horizontal cross-cutting first. This operation involves the stopping of the reciprocating movement of the table, the application of a reciprocatory movement to one of the cross slide tool heads, the stopping of the cross feed motion of the cross slide tool heads, and the application of a longitudinal feed motion to the table. Incidentally, the operation also involves a change at the cross slide tool head, the relieving action of which for longitudinal planing is in the wrong direction for cross planing; a supplementary relieving tool holder giving relief in the crosswise direction has to be attached to the cross slide clapper, as shown on the right-hand head in Fig. 4.

All the electrical changes required for cross planing are effected in a moment by the operation of a multiple pole enclosed switch L, Fig. 1. When this switch is changed over, the main table-driving motor C is cut completely out of action. In addition, the supplementary motor K, Fig. 2, is by the same operation converted from a feeding or traversing motor into a reversing motor for the reciprocation of the cross slide head. Further, a second supplementary motor, J—Fig. 1—is by the same switch movement connected electrically to supply the table feed motion. Mechanically, the motor J has to be connected to the table by the movement of an excentrically mounted worm on the driving side of the machine. Going round to the control side, the operator throws the lever V, Fig. 2, over to the right. As a result of this movement, the stroke disc D and the master switch associated with it are transferred from their action in conjunction with the table to action in conjunction with the vertical shaft P. The procedure for changing from table to cross planing may appear complicated when described in print, but in practice it is not so. Excluding the changing and setting of the tool, we ourselves, although strange to the machine, performed the necessary operations in $1\frac{1}{4}$ min.

As set for cross planing, the disc D is geared not to the table, but to the shaft P. Its dogs acting on the master switch no longer control the direction of rotation of the table motor C, Fig. 1, but instead control the direction of rotation of the supplementary motor K, which has now become a motor of the reversing kind. The control levers at Q, page 190, being correctly set, the supplementary motor K and the disc D produce a reciprocatory motion of the cross slide tool head through any desired range. The motor K is of the same split field type as the main table motor C, and accelerates the idle return stroke of the tool head in the same manner as the motor C accelerates the return stroke of the table. Variation of the cutting speed given to the head is produced by varying the voltage supplied to the motor.

The second supplementary motor J is electrically connected to come into action at the end of each return stroke of the cross slide head. It can be set to make either, a half or a full turn per cycle, corresponding to table feeds of $^1/_{32}$in. and $^1/_{16}$in. The feed gear details illustrated in Fig. 2 are absorbed in the reciprocatory drive of the cross slide tool head, and do not play any part in feeding the table for cross planing. The feed of the tool vertically downwards into the work is effected manually by means of a handle applied to the end of the central spline shaft in the cross slide. The necessary connection between this spline shaft and a vertical slide, forming part of the tool head, is effected by means of a small selector handle on the body of the tool head. The feeds during the cross planing operation are as instantaneous as during the longitudinal table planing operation, a fact representing no mean accomplishment when it is remembered that the feed motion involves moving not only the work but a table weighing 20 tons.

The right-hand tool head alone is arranged for planing vertically down the end of the work. The cut is taken not by causing the cross slide as a whole to move up and down, but applying a reciprocatory movement to the vertical slide, already referred to, forming part of the tool head. The tool holder employed is that used for cross

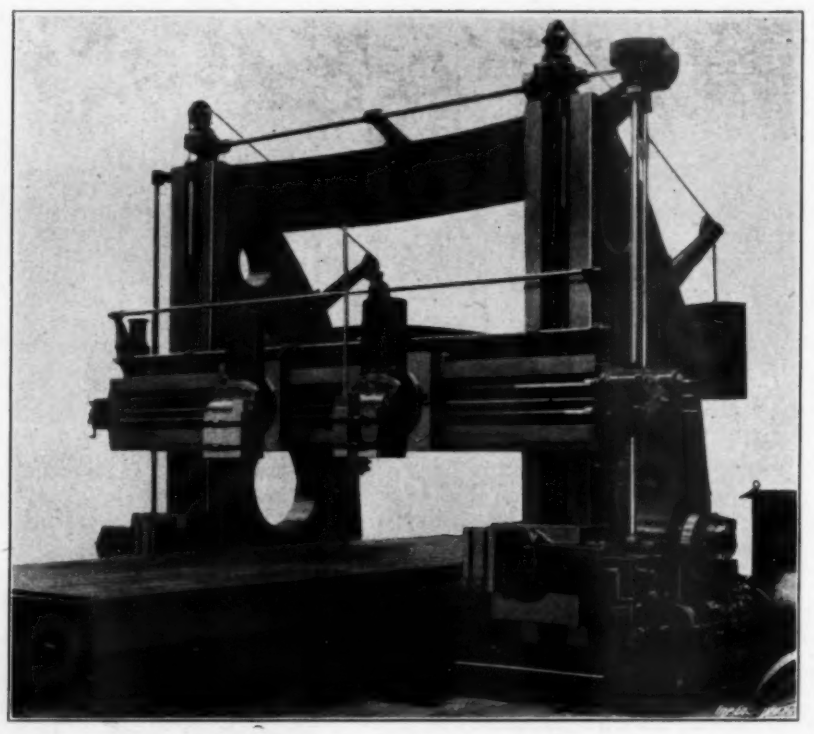


FIG. 4—CONTROL SIDE OF MACHINE

planing, but set horizontally instead of vertically. The vertical end planing operation requires a feed of the cross slide tool head of exactly the same kind as that employed for ordinary longitudinal planing. The feed gear details shown in Fig. 2 are therefore restored to their original function, the motor K, however, being now set to make a half or a complete turn at the end of every return stroke of the tool head slide. The reciprocatory movement of the tool head slide is communicated by the supplementary motor J, which, for this purpose, is disconnected by means of sliding gears from the table and applied instead to the vertical shaft U, page 190. Thence the transmission is carried along the horizontal spline shaft of the cross slide to the tool head. The motor J is of the split field reversing type, and during this vertical planing process is under the control of the stroke disc D, Fig. 2, which in the usual way is set

to give the required length of vertical stroke to the tool head slide. In this method of working feed in the longitudinal direction would involve a movement of the table and the work. In general, it is preferable to set the tool into the full depth to begin with and take the feed solely in the cross direction. If two traverses or more are required the table can be moved up by means of the main driving motor C.

Vertical planing down the sides of the work is accomplished by re-coupling the motor J to the table for feeding purposes, and by coupling one or other or both of the side tool heads to the shaft P or U. The motor K is set to act as a reversing motor under the control of the disc D, which, as in cross planing, is geared to the shaft P. The automatic feeds, as in vertical end planing, are $^1/_{32}$in. and $^1/_{44}$in. Feeding for depth is accomplished by hand. The transmission of power from the shaft P to the shaft U, if the left-hand side head is to be used, is effected by way of the splined central shaft in the cross slide. The vertical movement of the side heads, whether for feeding or power traversing purposes, is fully protected by safety trips, which switch off the power should the side heads be moved too far down or be on the point of colliding with the cross slide. Similar trips are also provided to limit the vertical movement of the cross slide.

To take a horizontal cut across the end, the motor K is set to reciprocate the tool head on the cross slide as for cross planing on the top surface, and the motor J is set to feed the tool head slide downwards.

Long Distance Gas Transmission in Saxony.

THE British Consul at Leipzig has forwarded to the Department of Overseas Trade a survey of the position with regard to the long-distance transmission of gas in East Saxony and the prospects in Anhalt, from which the following particulars are taken :—

In East Saxony small gasworks are being shut down more and more, and the areas they supplied are being incorporated in the districts served by large gasworks. It is being increasingly recognised that the interests of the principles of heating are better served by confining production to a few main centres. To this recognition is due largely the founding of the company known as the "Gasversorgung Ostachsen A.G.," in Dresden (Gosag), which is to undertake the uniform provision of gas for East Saxony from one central plant, namely, the large gasworks in Heidenau, which is near Pirna, on the Elbe, a short distance to the south-east of Dresden. This company was founded in 1922, the main shareholders being the Thüringer Gasgesellschaft Leipzig, the Elektra-Aktiengesellschaft Dresden (which is largely controlled by the State), and the Gas Union of East Saxony in Heidenau. The last mentioned embraces the majority of the communities served by the "Gasversorgung Ostachsen A.G."

The new company is built up on the large gasworks at Heidenau, which were formerly in the possession of the Thüringer Gesellschaft, and were brought into the new company, together with all pipe lines, &c. When the "Gosag" took over the old works, it at once proceeded to make extensions, in order to provide for the expected increase in the consumption of gas. At the same time it endeavoured to widen the area of consumption. In 1925 the necessary negotiations were concluded, and a large number of new communities brought in. These communities lie mostly along the railway line Bischofswerda–Zittau. At the present time 100 communities, including seventeen towns, are served by the "Gosag," the population of the area thus supplied being about 200,000.

Not only has there been a great development in the extension of the field of supply—greatly favoured by the work which the Thüringer Gesellschaft had already carried out—but there has also been a great development in the business side of the organisation. All the works have been thoroughly reorganised, as have also the propaganda and selling organisations. New plants have been created at different points and at the present time there exist the following branch works :—Königstein, Pirna-copitz, Berggiesshübel, Dippoldiswalde, Freital, Pulsnitz, Neukirch, Kirschau, Sohland, Neusalza-Spremberg. These outside works are regularly visited by representatives of the chief office and co-operation is also furthered by quarterly meetings of the chief employees of all sub-branches and works.

The development of the system is naturally not yet completed, but it will be continued in the future in accordance with economic development. In 1926 a contract was made for the supply of gas to the electric light union of Gröba. This union intends to supply the district it covers with gas as well as electricity, and to draw that gas from the "Gosag." The first part of this development embraces over thirty communities. The pipe lines of the "Gosag" have at the present time a length of over 800 kiloms., and the system is said to be one of the largest of the kind in Germany.

The following are the five main lines of supply :—

(1) Pirna–Königstein, with gasometers in Pirna and Königstein.

(2) Heidenau–Freital, with a gasometer in Freital.

(3) Heidenau–Berggiesshübel, with gasometers in Berggiesshübel and Zuschendorf.

(4) Heidenau–Dippolswalde, with a gasometer in Dippoldiswalde.

(5) Heidenau – Copitz – Bischofswerda – Neusalza – Spremberg, with gasometers in Copitz and Bischofswerda.

Anhalt.—The question of long-distance gas transmission received some attention at the last general meeting, held recently, of the Deutsche Continental Gasgesellschaft, Dessau, Anhalt. One of the directors was of the opinion that gas transmission over very long distances could not compete with large gasworks. The provision of gas within a radius of from 150 kiloms. to 200 kiloms. from the gasworks could be considered. In Germany, besides the natural regions of gas production, such as Westphalia, the Central German lignite fields and Silesia, large gasworks would probably be developed in other districts, each work supplying its own particular economic area. The question was largely one of transport and the policies of the railways and of the canals would be of considerable importance. On account of these factors and in order to remain independent and to guard against monopolistic amalgamations, the company had acquired a field of hard and gas coal, estimated to contain two milliard tons.

The question of long-distance transmission is one of very great importance for lignite, the exploitation of which might suffer considerably. It is reported that a committee of inquiry is to be appointed in the near future to study the problem of lignite in relation to gas production and transmission.

ENGINEER AND CLIENT.

A MATTER which perhaps causes as much trouble between the engineer or the architect and the client, says the Institution of Structural Engineers in a communication just received, is the vexed question of fees. In many cases it is chiefly the fault of the engineer or architect that trouble arises, because (*a*) he does not furnish the client with his scale of fees, and (*b*) he gets no sort of contract from the client to pay any particular fees. The average client always imagines that he is being over-charged, as does the client with most professional men, because he can never understand that he is paying for experience acquired and an expensive education, as well as for work done. The Institution of Structional Engineers has now produced a form of contract between the consulting structural engineer on the one hand and the client on the other. There are two distinct forms, one for use where a Bill in Parliament for the works to be executed is necessary—form "B"—and one where a Bill is not contemplated—form "A." Each document is accompanied by a printed explanatory form, which sets out the procedure to be followed so clearly and lucidly that the aid of a lawyer is rendered quite unnecessary. Each document sets out explicitly the work to be done by the engineer and his responsibility, the method and times of payment of his fees, and contains provision for payment in the event of extra work being carried out or in the event of the works being abandoned. The fees themselves are not specifically mentioned, but the client agrees to pay the Institution scale fees. The document is a very valuable one from the point of view of both parties, because, on the one hand, it binds the engineer to the proper carrying out of certain duties for the client, and, on the other hand, it binds the client to pay the proper scale fees for the work which is being carried out. It is the more valuable in that it secures payment for extra or abandoned work. The documents were drawn up by the Practice Committee of the Institution, in conjunction with the Institution solicitors—Messrs Wild, Collins and Crosse—and has been approved by counsel. Each form is on sale, price 1s., and may be obtained from the secretary, the Institution of Structural Engineers, 10, Upper Belgrave-street, S.W. 1.

INSTITUTION OF ELECTRICAL ENGINEERS.

AT the annual dinner of the Institution of Electrical Engineers, held at the Hotel Cecil on Thursday, February 10th, the Prince of Wales was the principal guest, and Dr. Eccles, the President, occupied the chair. In proposing the toast of "The Institution of Electrical Engineers," the Prince made an excellent speech, in which he referred to the remarkable achievements of electrical engineers, and notably to that of establishing a wireless telephony service across the Atlantic. The inventions of British engineers were, he said, known throughout the world, and there was no limit to what they could do and invent. It was up to the industries to utilise those inventions. Although the period of preparation by research before science could offer the world some new benefit might be long, the scientific machine was always running in the laboratory. The general public could never know the amount of hard work and brain power expended in keeping that machine running. Only those behind the scenes could appreciate the difficulties that had to be overcome, and the patient skill which had to be exercised over a period lasting perhaps for many years. Individual effort alone would not keep the machine running smoothly, and in the absence of the various scientific and technical institutions, such as the Institution of Electrical Engineers, it might come to a standstill. The Institution of Electrical Engineers bridged a great gulf between pure science and practical science. If the people of this country and of the Empire did their duty, he was quite sure that electrical engineers would deliver the goods. He wished the members every possible success, and asked them to drink the health of the great institution—the Institution of Electrical Engineers.

In replying to the toast, Dr. Eccles said that the Prince's speech could be taken as a compliment to the present status of the whole electrical industry, and as a recognition of its rising prestige. The growth of the industry in the Empire had been remarkable, for in less than a century the capital invested had risen from nothing to more than a thousand million sterling. The immediate question was whether Britain, which was the workshop of the world during the steam age, could take a leading place in the expanding electrical age, or were the complications of the electrical machinery of the future going to prove too much for the country's engineers ? The question could be answered, he believed, by glancing at the electrical record of the past year or so. Last year Englishmen laid in the Pacific the longest submarine cable in the world of the most modern type, whilst at the begininng of the year the Post Office opened its wireless station at Rugby, and its signals were received all over the globe.

Colonel Wilfrid Ashley, Minister of Transport, replying to the toast of "Our Guests," which had been proposed by Dr. Forranti, said that the Electricity Act had caused members of the Government—and himself—a great deal of trouble, and there may have been some who questioned the wisdom of its provisions. But the answer with regard to its wisdom had been provided by the President of the Institution, who had pointed out that during the time that the Bill was before Parliament the manufacturers of this country exported no less than £20,000,000 worth of goods.

VEREIN DEUTSCHER INGENIEURE, 1856–1926.

LAST year marked the seventieth anniversary of the founding of the Verein Deutscher Ingenieure, or the Society of German Engineers. This event was fittingly celebrated by the publication in Germany of a pleasing book containing a historical review of the activities of the Society. It was written by the present Director of the Society, Dr. Conrad Matschoss. From its pages we learn that the Society was brought into being on May 12th, 1856, on the occasion of a Whitsuntide outing held at Alexisbad, in the Harz district. This, we may perhaps remark, was also the year which in England saw, in the January, the first issue of THE ENGINEER. In Germany, as in our own country, mechanical engineering was at that time characterised by a remarkable stage of growth, and a need was felt for a society which would embrace the whole field of engineering, industrial and scientific development, with a technical journal which would be circulated among its members. The new members of the Society were largely drawn from the Hütte Verein, which in 1846 had been founded by Friedrich Euler in Berlin. It was Euler who became the first president of the new Society, and the position of director was ably filled by Franz Grashof, who subsequently took charge of the V.D.I. *Journal*, which was first published in January, 1857—just a year after THE ENGINEER. At first the *Journal* appeared as a monthly publication, but in 1884 it was issued weekly. Director Matschoss, who is always happy when dealing with historical subjects, traces with evident pride the rapid growth of the institution, which embraces many provincial groups, and he enumerates the more important annual meetings which have been held in different towns throughout Germany. He divides the more historical part of his story into three periods, first dealing with the progress made between 1857 and the twenty-fifth anniversary of the Society ; secondly, with the interval from 1881 to 1914 ; and thirdly, with the new period extending from the year of the war until the present time. Some illustrations are given of the commodious new home of the V.D.I. at Ingenieurhaus, near the Reichstag, in Berlin. Practically half of the book is devoted to the many-sided work of the Society, both in its relation to industry and to other technical organisations. The literary work of the V.D.I., which began in 1857 with the founding of the V.D.I. *Journal*, has now so increased that besides books no less then eleven technical journals which deal with varied aspects of industry and research are now regularly published by the Society.

THE INSTITUTION OF CHEMICAL ENGINEERS.

THE Institution of Chemical Engineers proposes to hold a conference at Burlington House, Piccadilly, London, W. 1, on Wednesday and Thursday, March 9th and 10th, 1927. The following programme has been arranged :—

Wednesday, March 9th, 1927, *at Burlington House.*—5 p.m., "Lead Burning" and "Lead as a Constructional Material in Chemical Engineering." Two papers : (*a*) "The Production of Dissolved Acetylene and its Application to Lead Burning," by W. C. Freeman ; (*b*) "Lead as a Constructional Material in Chemical Engineering," by S. J. Tungay (Member). 6.45 p.m., informal dinner (Stewart's Restaurant). 8 p.m., "Modern Methods in Sulphuric Acid Manufacture." Two papers : (*a*) "The Function of the Schmiedel Box in Sulphuric Acid Manufacture," by H. J. Bush, M.Sc., Ph.D., and A. Grounds, B.Sc. Tech., A.I.C.; (*b*) "Some Improvements in Chamber Sulphuric Acid Plant," by W. G. Mills.

Thursday, March 10th, 1927.—12.30 p.m., visit to the Fuel Research Station, East Greenwich. At Burlington House, 5 p.m., "Rubber as a Constructional Material in Chemical Engineering," by B. D. Porritt. 6.45 p.m., informal dinner (Stewart's Restaurant). 8 p.m., "The Effect of Heat on some of the Properties of Metals," by Professor F. C. Lea.

Friday, March 11th, 1927, at Hotel Victoria.—11.30 a.m., fifth annual corporate meeting. 12 noon, president's address, "Some Industrial Developments and the Chemical Engineer," by Sir Frederick Nathan, K.B.E. 12.45 p.m., informal lunch. 2.30 p.m., "The Cross Cracking Process and Plant," by F. H. Rogers. 7.30 for 8 p.m., annual dinner.

SWITCHGEAR CELLS AND CUBICLES.

THE British Engineering Standards Association has recently issued a Specification for Switchgear Cells and Cubicles constructed of moulded stone (B.S. Specification No. 268–1926). The specification is divided into two parts, indicating the principles to be followed in the construction of (1) cubicles constructed from pre-cast units, (2) cubicles constructed in place.

It defines the terms "concrete," "slabs," and "mouldings," and indicates the materials to be employed and method of mixing in the preparation of "concrete." It defines the finish of "slabs" and "mouldings" and lays down acceptance tests to be made at periods from four to twelve weeks in the age of the slabs. In the case of mouldings, tests are to be made on slabs taken from the same mix as the mouldings. The tests consist of the application of an evenly distributed load on a central area, the width of the slabs and parallel to the ends where they are freely supported. The specification indicates the general principles to be followed in the design of cubicles. The specification is of special interest to all switchgear purchasers and manufacturers, since the sound construction of cells is of the utmost importance in connection with modern switchgear where complete phase separation and also the separation of individual apparatus are essential features, which can only be properly attained by the use of good quality materials employed in a suitable manner. Copies of this new B.S. specification may be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, S.W. 1, price 2s. 2d. post free.

South African Engineering Notes.

South African Coal.

In the last three years the coal output of the Union of South Africa has increased at a rapid rate. As far back as 1916 an output of just over ten million tons was reached, but it was not until 1920 that it exceeded eleven millions, the exact quantity being 11,473,464 tons. The year 1923 saw 11,917,036 tons reached, and since then each year there has been a big jump. The total for 1924 was 12,491,905 tons, and for 1925 12,999,666 tons, and the output for the ten months ended October 31st of last year amounted to 11,231,472 tons. If the average for the year, up to that date, was maintained throughout, the total for the year should have reached 13,477,766 tons. Moreover, if the average for the last six months were maintained, the total would have reached but a trifle short of 14 million tons; but, with the end of the coal strike in Britain, the abnormal demand which sprung up about August speedily disappeared and exports of coal tended to return to normal.

The increasing demand for South African coal has not come from outside the country, however, if the increase brought about by the British coal strike is ignored. During 1925 the quantity of coal exported from South African ports to other countries, together with the quantity supplied to steamers for bunkers, was 2,991,378 tons, and actually less than the total of 3,047,179 tons for the year 1924. Last year there had been shipped up to the end of October, 2,523,222 tons, as compared with 2,324,754 tons in 1925 during the corresponding period. This increase of 200,000 tons was practically wholly due to the British coal strike, as the monthly export figures clearly show. It is, therefore, obvious that the yearly increases in the output of the Union collieries is entirely due to the expansion of the country's industries

Like practically everything else in the Union, the coal-mining industry is in large degree being carried on the back of the gold industry. The coal consumed by the Vereeniging Falls Lower Company's stations, which supply the gold mines with power, is an enormous item, and, of course, over and above this there are the direct purchases of coal for the steam-operated plants of the gold mines, for which a sum of £2,250,000 is paid annually. The demands of the mines are not, however, increasing to any appreciable extent at present, nor are they likely to in the future, and it must therefore be other industries which are responsible. Among them the demands of the big electric power stations at Witbank (Transvaal) and Colenso (Natal) bulk largely. In addition, many municipalities have recently installed electrical plants, while the large cities have had to make extensive additions to their existing plants and machinery in order to supply the increasing private consumption, and the numerous new factories which have been, and are being, built. There has never been a period when so many factories were in course of construction, and, being planned, as the present, the high Customs Tariff imposed recently—1925 and 1926—being largely responsible. The pig iron industry which started last year is also calling for many thousands of tons of coal for coke, per annum, and so are the big extensions to the Union Steel Works, and the requirements of the wire and galvanised and corrugated sheet works, &c., which the manufacture of pig iron in this country is bringing into existence. The new power stations at the Congella (Natal) and Salt River (Cape), each with 30,000-kilowatt plants, will make further demands on the coal mines, and to put the output necessary to provide for the 1927 demands at well over 14,000,000 tons seems a moderate estimate. The known coal resources of the Union are, of course, sufficient, at anything like the present output, for ages to come, as the total quantity is estimated at over 50,000,000,000 tons, but not nearly all of it is of high grade, and a considerable proportion is very inferior.

It is therefore satisfactory to be able to record that during the past year the Coronation Collieries, Ltd., has added to its undertaking a new property, in the Kromdraai District of the Transvaal, which has been proved to contain a very extensive area of coal carrying exceptionally high values.

The mining experts who carried out a complete investigation report that "the coal area proved is a very extensive one, having a length of 5 miles from north to south and a width varying from 1½ miles at the narrower point up to 2 miles at the wider point. There are two seams underlying the property, the lower one, or No. 1 Witbank Seam, at an average depth of about 92ft.; and the upper, or No. 2 seam, at an average depth of about 80ft. The thickness of the No. 1 Seam varies from 7ft. to 11ft., and the calorific value of the coal in the boreholes—forty boreholes in all were sunk—runs from 13·0 lb. to 13·7 lb. per pound. The thickness of the No. 2 Seam averages about 17ft., the upper two-thirds of which is generally of poor quality, but in one-third of the boreholes the lower 5ft. or 6ft. has a calorific value of about 13 lb. per pound. An incline shaft has been put down about the centre of the property, and through it it is hoped to work about 1500 acres of the lower seam; a second shaft could be sunk about 1½ miles north of the existing shaft, and would serve a rather larger area containing the lower seam. A third shaft, situated about 1½ miles south of the existing shaft, would serve an area larger than either of the other two, which also contains the lower seam. The upper seam could be profitably worked over an area of about 1500 acres. The incline shaft which has been put down near the centre of the property, has a slope of 1ft. in 8ft., and has been equipped with an endless haulage. The total length of this incline, from the bottom of the seam to the top of the open cutting at ground level, is 1050ft. The coal has been opened up at the bottom of the incline shaft for a distance of about 300ft., the thickness of the seam is 11ft., and the seam itself is clean throughout. The calorific value of the coal sampled in this seam has been in the neighbourhood of 13·5 lb. per pound."

A test of the coal in the seam which was carried out by Mr. J. Q. Braidwood, on account of the Transvaal Coal Owners' Association, gave the following result:—Moisture, 1·78; volatile matter, 23·51; fixed carbon, 65·64; ash, 9·07; total, 100 per cent.; calorific value, 13·42, over 11ft. 8in. The present plant is designed to deal with an output of 40,000 tons per month, but of it one unit only has been completed; this unit will deal with an output of 20,000 tons per month. The work of sinking the shaft and equipping the colliery was commenced on February 15th, 1926, and was completed by October 15th, or over a period of eight months. The construction of the railway siding is now completed up to the mine, and the first few trucks of coal were sent away on November 23rd.

The Coronation Collieries, Ltd., also owns the Vryheid Coronation, Ltd., in Natal, which has now completed thirty-four months as a producer of coal and twenty-four months as a producer of coke. The output of coal and coke have been as follows:—Ten months to October 31st, 1924, 51,717 tons of coal; twelve months to October 31st, 1925, 170,994 tons of coal and 7801 tons of coke; twelve months to October 31st, 1926, 191,791 tons of coal, 11,313 tons of coke. The coal produced on this property continues to be of exceptionally high quality, the calorific value being 14·0 lb. to 14·5 lb. per pound. During 1926 the coke oven plant was added to, bringing the capacity up to 1600 tons per month. The colliery is equipped for an output of 25,000 tons per month. It may be added that during 1925 the value per ton of the coal produced in the Transvaal was 4s. 11·46d. at the pit's mouth, and of Natal coal 7s. 2·22d. at the pit's mouth.

Other colliery companies have also been testing the areas of land held by them with excellent results. One of these companies, the Transvaal and Delagoa Bay Investment Company, Ltd., has had particularly satisfactory reports from their technical staff. Of the company's holding of 280,000 acres, no less than 50,000 acres are now proved coal-bearing land. This coal-bearing land is situated in the Witbank and Wakkerstroom Districts—the richest coal districts in the Transvaal—and represents an asset of great potential value.

Big Platinum Plant.

The Potgietersrust Platinums, Ltd., having thoroughly tested its platinum area, in the Potgietersrust District, by the aid of its pilot plant, is so thoroughly satisfied that it is proceeding with the erection of a large milling and extraction plant that will work on the scale of the big Rand Gold Mines. The company has just concluded a contract with the Griffin Engineering Company, Ltd., for the transport of from 1500 tons to 2000 tons per month of machinery and supplies from Potgietersrust Station to the Potgietersrust Platinum Mines—a distance of about 18 miles. Super-Sentinel tractors and wagons are being used. This large Platinum Company has also acquired all the holdings of the Rustenburg Platinums, Ltd., and Premier Rustenburg Platinum, Ltd. The Rustenburg Platinums, Ltd., thus hands over to the Potgietersrust Platinums, Ltd., 51 farms having a total area of 100,236 morgen (a morgen is a trifle over 2 acres), in exchange for 450,000 Potgietersrust Platinums 5s. shares. The other Rustenburg will receive the same consideration for its properties, the exact extent of which have not been made public. The Potgietersrust Company is increasing the capital by £250,000, divided into 1,000,000 shares of 5s. A big programme of development will be proceeded with at once on the Rustenburg properties.

Cape Town's Mountain Cableway.

It is understood that the Table Mountain Aerial Cableway Company, Ltd., has placed a contract for the passenger transporter gear, required for the company's intended service up the mountain, with Adolf Bleichert and Co., of Germany. According to the agreement entered into by the Cableway Company with the Cape Town Corporation, operations were to be begun not later than October 1st, 1926, and the work has to be finished within three years of that date. Driving power will be electricity from the Corporation's network, the company having the right to install and maintain auxiliary oil-engines for emergency purposes. The Council is assisting in the construction of an approach road to the bottom station of the line. It is to be regretted that yet another important contract has been gained by a German firm. British firms have for some time been losing more S.A. contracts than they have gained.

Durban's Grain Elevator.

During the week ended December 11th excellent progress was made in the erection of the Durban grain elevator, the departmental engineers having created a record by raising the storage section at an average rate of 10ft. per shift. There are 50 bins over 18ft. in diameter, and 36 interspace bins. The overall dimensions are 100ft. by 190ft. by 90ft. high. The storage capacity is 27,000 tons, which, with 15,000 tons in the working house section, gives Durban a terminal elevator capacity of 42,000 tons. Day and night shifts have been employed on the work, and the most interesting feature has been the raising of forms, platforms, scaffolding, and men by an elaborate system of jacks. Jacking takes less than half an hour, so that work on all sections is quickly resumed. It is this system that is responsible for the remarkable rapidity attained. Over 5000 cubic yards of concrete and 150 tons of reinforcing steel have been put into the storage bins in a week. The larger working house section has already been completed, and the assurance is now given that the elevator will be ready before the next maize season ends.

New Durban North Bridge.

In addition to a massive steel bridge now being constructed across the Umgeni River at Durban, the promoters of the Durban North model village scheme have decided to ease the gradient of one portion of the main road through their property by the provision of what will be the longest concrete bridge erected by private enterprise in the Union. The total length of this bridge will be 540ft., comprising five 82ft. and two 45ft. spans. The maximum height above the ground will be 60ft.

Port Elizabeth Harbour.

Considerable reclamation work is contemplated on the foreshore at Port Elizabeth for the purpose of improving railway access to the piers. The facilities for handling cargo are shortly to be added to by two mobile cranes, of the petrol-electric type, capable of handling 2-tons and of manœuvring in confined spaces. The establishment of two hydraulic cranes near what is known as the machinery shed has been wonderfully successful, and equally effective has been the loading bank in that vicinity, particularly in connection with the copper transport trade. The Union Minière du Haut Katanga has been sending large consignments of copper, averaging about 4000 tons monthly, from its big copper mine in the Belgium Congo through this port during the last year. The firm is also importing its heavy machinery of all kinds through Port Elizabeth, and these items have materially swelled the monthly totals of cargo handled at the port.

New Plant for Rand Mine.

Five Oliver continuous filters, each 14ft. by 16ft., will be included in the new plant of the West Rand Consolidated Mines. These filters will be the largest installed in Africa. They are of the same size as those used by the Hollinger Consolidated Gold Mines, which has five of these Oliver filters at work. When the West Rand Consolidated's new plant is completed it will have a capacity of 80,000 tons per month, or nearly one million tons per annum, and an even larger capacity plant than it may eventually be installed. Excavations for the new crusher station are well advanced, and the crushing plant has been ordered from Europe. In addition, orders have been placed for the tube mill plant, consisting of eight tube mills with motors, for three electric locomotives, and twenty hopper trucks required under the new scheme for surface transport, and for two air compressors with a total capacity of 15,000 cubic feet of free air per minute. Exact details of the metallurgical scheme to be adopted at the West Rand should be available in the near future.

Union Miniere Progress.

The progress which the Union Minière du Haut Katanga has made in the past fourteen years has been great. In 1911 the mine produced 997 metric tons, in 1912 2492 tons, in 1916 the total had gone over the 20,000 ton mark, and in 1921 it reached 30,000 tons. The yearly increases then became larger, the 1922 total being 43,362 tons and the 1923 figure 57,889 tons. In 1925 the record total of 90,020 tons of copper was produced, the ore raised in that year amounting to over 2,000,000 tons. The work that is being carried on at present includes the erection of reverberatory furnaces with a capacity of 30,000 to 40,000 tons of copper per annum, and an increase of 30,000 kilowatts in the power station.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Awaiting Lower Prices.

CONSUMERS of iron and steel in the Midlands and Staffordshire continue to withhold orders pending a reduction of values. They state that prices must fall considerably below present levels before they will purchase more material than they require for immediate working up. Producers for the most part maintain recent quotations, so that between their refusal to lower their prices and the refusal of consumers to pay what is demanded, the tonnage which changes hands does not amount to much. Consequently revival of activity in the iron and steel industries is still postponed. When the deadlock in the coalfields was removed, it was assumed that there would be an almost immediate release of new business. This has proved to be a miscalculation. The demand that was held in suppression last year by the coal famine is restrained this year by the failure to arrive at a price level agreeable alike to producer and consumer.

Iron and Steel Recovery.

An address delivered by Sir William J. Larke, director of the National Federation of Iron and Steel Manufacturers, before the Birmingham Chamber of Commerce, on the 10th inst., has created something of a stir in Midland industrial circles. The figures quoted by Sir William furnish undoubted proof of the progress being made in the iron and steel industries towards recovery of normal activity. Sir William stated that as a consequence of accumulated demands after the coal strike, last December witnessed a remarkable effort. At the end of the month 78 blast-furnaces were in operation and at the end of January 150, or more than were in blast at the commencement of the strike. The number likely to be operating at the end of the present month should exceed 160. That was a wonderful testimony to all concerned. The production of steel in January, according to the incomplete figures available, reached 720,000 tons, whereas in January, 1926, it was 640,000 tons. They had therefore exceeded the output of a year ago, in spite of the coal stoppage and the fact that they had only six or eight weeks in which to get restarted. There was a proper feeling of reasonable optimism about just now, but let them not think there was anything in the nature of a boom. That was the last thing they wanted, but there were many months of industrial activity before them.

Rapid Expansion of Output.

Midland engineers who for the past two months have been virtually fighting for supplies of iron and steel, were mildly surprised at the statistics of production issued this week by the National Federation of Iron and Steel Manufacturers. They could hardly realise that the production of steel ingots and castings in January amounted to 730,700 tons, or practically twice the amount produced in the previous month and 69,700 tons in excess of the output in April last year. When one considers that 75 additional blast-furnaces were blown in during January, making a total operating of 152, the figures relating to pig iron are not so astounding. That rapid strides are being made to regain normal output in this department is, however, shown. The output of pig iron last month,

which amounted to 434,600 tons, compared with 98,000 tons in December, 539,100 tons in April, and 533,500 tons in January, 1926. The production, it is noted, included 142,500 tons of hematite, 154,100 tons of basic, 101,300 tons of foundry, and 17,400 tons of forge.

Black Country's Future.

An optimistic note with regard to trade prospects in the principal staple industries of the Black Country was struck by speakers at the annual dinner of the Staffordshire Iron and Steel Institute at Dudley on Saturday last. There was no falsely induced optimism about the speeches, but a reflection of the generally hopeful outlook of those with their fingers on the pulse of the Black Country's most typical industries. Enthusiasm was based on a knowledge of the capacity of Staffordshire firms and their workers to meet the demands that will be laid upon them, on the comprehension of the probable extent of those demands, and on a realisation that, after the events of 1926, both employers and workers are anxious for peace and prosperity. Lord Ednam said that in the iron and steel trades there was a brighter outlook than had been experienced during the last five or six years. He thought that when the results of the coal stoppage had settled down, when prices had ceased fluctuating, and when there was more confidence, the trade would be in a better position than it had been for a considerable time. It was probable that for some years those engaged in the iron and steel trades would have a very hard struggle, but there was no need for them to be unduly depressed; in fact, he thought they could look forward in the near future to a very much brighter prospect. He hoped to see the day when the Black Country was more prosperous than it had ever been.

Trade Union Legislation.

There is a pretty general opinion in Midland industrial circles that the coming parliamentary battle over trade union legislation, even though the Government proposals may not involve any drastic alteration of the trade union law, is likely to have serious industrial effects. There never was a time, they urge, when the very economic existence of this country more urgently demanded good feeling between capital and labour; when economic conditions—falling prices, the competition of cheap foreign labour, the burden of debt on industry—made it more difficult for capital and labour to appreciate one another's point of view. To increase labour suspicions by anything that looks even remotely like an attack on the industrial trade union is to render agreement almost impossible. The hope is expressed that Ministers will seek to convince Labour that they accept the trade unions as a necessary part of our policy and that they are anxious to legislate about them only so far as the country's welfare imperatively demands.

Birmingham Rates.

Birmingham industrialists learned this week with considerable relief that for the fifth year in succession there is to be no increase in the rates, which are to be kept down to 16s. in the pound. It is pointed out, however, that this will be possible only as a result of drastic reductions in the estimates of the various departments of the Corporation to absolutely essential expenditure, and in taking this course the Committees are actuated by the desire that no obstacle should be placed in the way of a trade revival. Largely as a result of the coal dispute, the grants in aid of rates from the trading departments will be only £58,700, as compared with £100,000 last year, whilst the higher cost of fuel and out-relief accounts for the Guardians' expenses necessitating a call of 4s. 8d. in the pound instead of 4s. 6d.

Pig Iron.

Output of pig iron is gradually increasing, but demand does not appear to have improved as a result of the smelters' expressed willingness to give concessions for forward contracts. For some time smelters will be able to produce on old contracts, but new orders will shortly be a necessity. Consumers hope that in a month or two easier prices will be the rule. Accordingly, supplies are being bought only from hand to mouth. There is so little disposition to contract over a period that it is difficult to say what concessions might be made to encourage forward buying. As blast-furnace coke remains scarce and dear, smelters are not going to commit themselves to transactions which may involve a loss if market depreciation is delayed. With foundry pig almost a drug on the market, and basic in very active demand, the adaptation of production to meet the case is claiming the attention of furnace owners. It is reported this week that a well-known battery of twelve blast-furnaces in Derbyshire, which has been in partial operation, is now ready to go ahead in its entirety, and that associated foundries are fully manned again. This concern is largely interested in the pipe trade, and is understood to have negotiated very big contracts at home and abroad. This is, however, by no means a typical instance, as in most cases furnace owners have not risked lighting more than one or two in the present state of the coke market. Quotations on 'Change to-day showed no change from those ruling a week ago. Northamptonshire forge was priced £3 13s.; No. 3 foundry, £4 to £4 2s. 6d.; Derbyshire forge, £3 18s.; No. 3 foundry, £4 2s. 6d. to £4 5s.—all at furnaces.

Blast-furnace Fuel.

Blast-furnace coke remains scarce and firm in price. Midland ironmasters complain that the coke ovens continue to disappoint them, but they are hopeful of much larger supplies before the present month is out. It is realised that after long disuse the ovens have required repairs in very many cases. It is stated that the output of blast-furnace coke has been larger than the consumption, but smelters will not incur the heavy expense of blowing furnaces in until they have accumulated sufficient reserves of fuel to safeguard them from breakdown. The output of the cokeries now is going very largely to replace the stocks which were exhausted during the stoppage. Hence it is still a seller's market. The price remains unshaken at 20s. at the ovens.

Finished Iron.

There is very little business passing in finished iron. Bar makers are endeavouring to stimulate demand by offering Crown bars at £12, but consumers are not responding. The quotation of £11 for common bars can be paid only by small local users. It is quite incompatible with the exigencies of the nut and bolt and hurdle trades. Black Country manufacturers are able to buy two tons of Belgian iron at the price of one ton of the home-produced material. After paying the carriage from Antwerp they effect a saving of some £4 15s. a ton. Makers of best bars continue busily engaged, and marked bars are maintained at £14 10s. per ton.

Steel.

In the steel trade the works are reported to be busy, and where any curtailment of production occurs it is generally through lack of trucks to dispose of the output. Steel mills when working normally require regular transport facilities in order to avoid congestion at the yards. The railway companies seem unable to cope with the traffic since the coal dispute ended. The rolling stock makers, who buy steel in large quantities, are well employed. Constructional engineers report an improvement in inquiry. Orders pending include lots of 100, 200 and 300 tons of steel. It is still difficult to obtain the heavier types of joists and sections, but plates are more plentiful, and possibly some weakness in this market may develop. Structural steel is being called for faster than it can be produced. Works are very stiff in their quotations of £7 17s. 6d. to £8 for angles and joists. There is great pressure for light joists and shipbuilding material. Though the mills are working hard, they do not appear to make much impression on the arrears. This is the most active department of the market. Small steel bars are offered at £8 15s. Continental semis are slightly dearer, soft billets being now quoted up to £5 9s. or £5 10s. Although imported steel is offered freely, complaint is made of slow deliveries. Belgian joists are offered at about £6 7s. 6d. delivered, as compared with British steel at £7 17s. 6d.

Galvanised Sheets.

In the galvanised sheet department pressure for lower prices has been yielded to, but the only effect has been to make potential buyers hold off for still more concessions. This week prices have given way further, and the basis for 24 gauge sheets is now £15 5s., though district mills decline to entertain less than £15 7s. 6d. for the home market. Business does not appear to have been stimulated, however, by these reductions.

Rolling Stock Contracts.

Orders for rolling stock for home and foreign railways continue to reach the Midlands. The Sentinel Waggon Works, Ltd., of Shrewsbury, have received orders from the Crown Agents for the Colonies for two Sentinel-Cammell steam railway coaches for the Ceylon Government Railways, these being additional to eleven similar rail coaches now being built for, and three already in service on, the Ceylon Government Railway's system. The same builders have received an order for a similar steam rail coach for the Gold Coast Government Railway and for four steam rail coaches for the Great Southern Railways (Ireland).

Obituary.

I regret to have to record the death since I wrote my last letter of Mr. William Fiddian, head of the firm of Fiddian and Deeley, engineers and surveyors, of Stourbridge. Mr. Fiddian was well known as the engineer to the Stour Valley Main Sewerage Board. In conjunction with his partner, Mr. P. Deeley, who has been appointed to succeed him, Mr. Fiddian had just completed the plans and arrangements for extensions to the sewerage works of the Board at a cost of over £49,000. In 1923 Mr. Fiddian resigned the post of engineer and surveyor of Stourbridge Main Drainage Board, which he had held for forty years, the joint sewerage scheme for Stourbridge, Oldswinford, Wollaston and Amblecote having been carried out by him in 1883 and 1884. When he resigned, he was appointed consulting engineer to the Board. He was also consulting engineer to the Stourbridge and District Water Board.

Unemployment.

After a slight check a week ago the unemployment barometer in the Midland area continues this week to fall. A further decrease of 6670 brings the total of wholly unemployed down to 153,124, of whom 108,544 are men. To the total the Birmingham area contributes 33,084, as against 34,963 in the previous return. In Coventry a further slight absorption of labour has brought the number unemployed to 2492. In every district in the area, with the exception of Smethwick, where there has been an increase of 17, the figures show a falling off from those of a week ago.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Textile Machinery.

SHIPMENTS of British textile machinery last month disclose no startling features. The total value was rather less than in the corresponding month of 1926, although about £28,000 higher than in December. Exports to Russia, which were valued at nearly £217,000 in the previous month, were down to £73,658 during the period under review, the most important market being the British East Indies with £201,000, followed by "other European countries," with £152,000. Russia with the amount stated; South America, £73,000; Japan, £70,000; France, £58,000; the Netherlands, £54,000; Germany, £36,000; the United States, £34,000; Australia, £32,000; and China, £25,000. Exports of spinning and twisting machinery were slightly lower than in December, at £670,000, shipments of weaving machinery, which were valued at £140,000, being responsible for the increased trade compared with the closing month of last year.

The Russian Market.

If the credit terms asked for by Mr. S. J. Emdine, a director of the All-Russian Textile Syndicate, in a statement published during the past week, are granted by Lancashire makers of textile machinery, the orders they received for the Russian market in the second half of 1925 will be completely overshadowed by those which, apparently, it is now contemplated placing. The question of a two years' credit, which is now asked for, compared with the eight months' credit granted in connection with the 1925 contracts, places the potential business on a very different footing, however, and it will be interesting to see what reception Mr. Emdine's plea receives in Lancashire. At the same time, it should be pointed out that textile machinists here recently expressed themselves as highly satisfied with the manner in which the financial obligations had been met by the Russian interests in connection with the orders placed some eighteen months ago. These, by the way, are fast approaching completion. The proposal of the Textile Syndicate is to increase the seven million spindles at present in operation in Russia by a further two millions, at a cost of between fourteen and fifteen million pounds. Last year's exports of textile machinery to all markets were valued at £9,957,000, and of this amount Russia was responsible for shipments to the value of £1,221,000.

Burden of the Rates.

In December, the officials of the Manchester Chamber of Commerce, as a bold step in the municipal economy campaign, laid before the civic heads a number of hard facts to illustrate the effects of the growing rates burden on industrial operations, and several engineering concerns were singled out as concrete examples. Sir Percy Woodhouse referred to the matter in the course of his Presidential address at the annual meeting of the Chamber of Commerce on Monday. As manufacturers could not control the price of raw materials, there was left, he said, only the field of labour and overhead charges. He believed that labour was entitled to its fair share of the fruits of industry, but when the fruits were losses it seemed to him that labour should share the burden, and, either by harder work or less pay, help to secure better trade. With regard to overhead charges, every manufacturer nowadays was cutting every avoidable expense to the bone. The one burden the manufacturer could not himself reduce was taxation, and some way must be found to reduce it. The representations of the Chamber and the incidence of rates on selling prices given by it were now being studied by the Corporation officials. With regard to national taxation, Sir Percy said he was anxious to emphasise that it would be disastrous to increase income tax, because it was already at a high enough level to be a grave burden.

Engineering in India.

The openings which India affords to young engineers were discussed by the President of the Institution of Civil Engineers, Mr. Frederick Palmer, at the annual meeting of the Manchester and District Association of that body. Without actual experience of them, he said, it was scarcely possible for engineers in England to conceive the magnitude of the engineering undertakings which were typical of India. In connection with them men were put into responsible positions in the twenties instead of having to wait, as they would have in this country, perhaps twenty years longer. The whole of the great trade and commerce of modern India, said Mr. Palmer, was entirely due to the work of the engineer. Sir Murdoch MacDonald, who also spoke, said the younger men might be entrusted with more responsibilities in engineering undertakings nearer home, and suggested that the older men in the engineering professions in this country might take the hint. Mr. S. J. Watson, Salford's electrical engineer, who occupied the chair, urged that the Council of the Institution should consider giving the local associations direct representation in its government.

Change of Control.

It is now officially announced that the recent agreement under which the control of the business of Charles Walmsley and Co., Ltd., engineers, of Elton, Bury, was to pass from Armstrong, Whitworth and Co., Ltd., into the hands of Mr. John Wolstenholme, the managing director, and friends associated with him in the business, has been carried into effect, the whole of the ordinary shares of the company having been acquired by a syndicate—the W.A.T. Syndicate, Ltd. Mr. Wolstenholme is now chairman of Charles Walmsley and Co., and Mr. William Adamson technical director.

A Locomotive Contract for Ceylon.

Beyer, Peacock and Co., Ltd., of Gorton, Manchester, have been awarded a contract by the Crown Agents for the Colonies for nine locomotives for service on the Ceylon Government Railways.

Non-ferrous Metals.

From the point of view of prices the net result of operations in the non-ferrous metal markets during the past week has been satisfactory, all sections, except tin, showing an improvement compared with a week ago. Up to last week end tin had registered an important gain, closing about £4 higher at £309 than the price quoted in this column for cash metal a week ago, buying having been rather active on bullish reports of reduced February exports from the East. Profit-taking in the early days of this week had a pronounced bearish effect. Particularly was this the case on Tuesday, when the whole of the gain was wiped out, leaving prices at roughly £1 a ton lower than they were a week ago. Heavy buying of copper, much of it of a speculative nature, has helped to raise prices in this section of the market from the abnormally low level reported here last week, and values are now back to where they were at the beginning of the month, although

still slightly below what they were during the last week in January. An improved demand for lead has been reflected in quotations for this metal, prices at the time of writing being about £1 10s. better than they were at last report, and a similar improvement can be recorded in the case of spelter due to some extent to heavier buying for industrial purposes.

Iron.

So far as new business is concerned, the market here, both for foundry iron and manufactured iron, has displayed no encouraging features, users limiting their purchases to early delivery of relatively small parcels, there being general indifference to fresh forward contracts. In spite of the state of the current demand, however, makers are busily engaged in coping with orders they already have on the books, and in some instances more blast-furnaces would be put into commission if there were less difficulty in securing plentiful supplies of coke. The high prices which pig iron producers have to pay for their fuel continue to have a steadying influence on quotations, and so far as near deliveries are concerned there seems to be little disposition to offer at lower rates than those that have been ruling during the last few weeks. Staffordshire and Derbyshire brands of pig iron for delivery into this area are in the neighbourhood of 93s. per ton, with Middlesbrough in short supply at 95s. to 96s.; Scottish at from 110s. to 116s. 6d., according to make; and West Coast hematite at about 97s. 6d. per ton. Lancashire makers of bar iron are meeting with a poor response from buyers, the demand being on very quiet lines, with Crown quality quoted at £11 15s. per ton and seconds at £10 15s.

Steel.

Although some sellers still report a fair volume of inquiry, it is doubtful whether much actual fresh business has been placed during the past week. For forward there has been talk of lower prices circulating, more especially from rollers, who perhaps are less favourably situated than others with orders still to be completed. As, however, there are plenty who have sufficient work in hand to occupy them for several months, there is no general disposition to cut prices for the time being. Boiler plates are quoted at about £11 10s. per ton, ship plates at £8 17s. 6d. to £9, joists at £7 17s. 6d. to £8, basic bars at £9 to £9 5s., and small re-rolled steel bars at about £9 per ton, all delivered into this area. Continental quotations on this market appear to be steadier than they have been latterly, and there are reports of a somewhat freer flow of orders being placed, though the improvement is slight. For delivery to works in the Manchester area for cash against shipping documents billets are quoted at £5 2s. 6d. to £5 5s., sheet bars at £5 7s. 6d., steel bars at £6 to £6 2s. 6d., joists at £6 2s. 6d., Siemens plates at £7 10s., and ordinary plates at £7 2s. 6d. to £7 5s. per ton. The demand for galvanised sheets for the export markets is on a disappointing scale, and quotations are weak at about £15 per ton for 24-gauge materials, with thin sheets also in slow demand for shipment to the East.

Scrap.

Prices for scrap non-ferrous metals have been rather steadier but business remains quiet. Zinc scrap is on offer at £25 10s., scrap lead at £26 10s., light copper at £54 to £55, selected gun-metal at £51, and heavy yellow brass at £44 per ton, for graded materials, delivered to users' works.

BARROW-IN-FURNESS.

Hematite.

There is not the life in the hematite pig iron market that one might have expected, and that there is not may be due to a number of causes. Price certainly is a factor, and the makers are faced with the same problem as regards fuel, &c. In the meantime manufacturers are busy making, and deliveries and requirements for the steel plants are practically keeping pace with the output. There are sixteen furnaces in blast now—including that on special iron at Backbarrow. Deliveries are pretty well distributed throughout the whole of the iron-buying districts, and the proportion of better class iron continues to be substantial. The orders which accumulated during the period of idleness are gradually being dealt with, and unless further orders come in there may have to be restriction of output; but, at the moment, that is a development which one does not anticipate, as it is known that the requirements of various customers are likely to be regular. In the meantime it is hoped that it will be possible to ease the price and thus tempt orders for forward deliveries. For some months yet makers will be engaged upon orders booked before the furnaces were again put in blast.

Steel.

The steel market is dull and fresh orders will have to be secured to assure a continuous run after the next three months are past. The mills at Barrow and Workington are kept busy at present, but a few months will see the completion of the contracts. As far as the hoop mills are concerned there is no fear of them not securing a sufficiency of orders. They are assured of a steady run.

SHEFFIELD.

(From our own Correspondent.)

The Open-hearth Steel Position.

THERE is little that is new to say about the production of open-hearth steel in the Sheffield district. Although it is on a scale in advance of anything that has been known since 1920, the productive capacity of the district is not fully occupied, and, while there is sufficient work on hand to last for a month or two, the outlook for new orders is still very unsatisfactory. It would appear that Sheffield is not progressing so rapidly towards normal trade as are the iron and steel centres of the North, and that we are still a long way from complete revival. The difficulty of high prices still remains. Merchants report that their sales of pig iron, scrap and crude steels are at a very low level. Cheaper pig iron is urgently desired, but it cannot be secured until there is a reduction in the price of coke, which is still scarce, and is making 20s. per ton, or 5s. 6d. more than the pre-strike rate. From most trades comes the report that ordering is only on a hand-to-mouth basis, and that there is an almost entire absence of speculative buying.

Some Lighter Branches.

Good reports come from some trades, chiefly those of a lighter character. The motor industry continues to be one of the city's best customers, and is providing a considerable volume of orders. Makers of special non-competitive lines are well off for work. There has been a fair demand for miners' tools, but the anticipated rush of orders for colliery equipment has not been realised. The present position of the coal trade is not altogether a happy one, as the output of coal is larger than the demand, and, as a consequence, colliery companies are severely restricting their purchases of plant. Substantial sales are reported by makers of tools required for road-making and quarrying.

Cutlery and Plate.

The condition of the cutlery and plate trades is still described as flat and unprofitable. Some orders are being sent forward by the travellers who are out on their journeys, but, generally speaking, the demand from the ordinary retail distributors is very moderate. Some good special contracts for the equipment of hotels and ships are still on hand. Valuable orders have recently been received for supplies of cutlery and electro-plate for the Irish Free State Army. Five Sheffield firms have secured contracts for the supplies which include some best quality plated table ware, flat and hollow-ware, and ivory knives for the officers and cheaper knives and forks for the men. The total value of the orders is several thousand pounds. The fifteenth annual report of the Sheffield Advisory Committee shows that that body is successfully continuing its work for the protection of the trade name of Sheffield. It states that the Federal Trade Commission has recently made orders against eleven traders in the United States of America requiring them in some cases to discontinue the use of the word "Sheffield" on goods which were not made in Sheffield and were not "Sheffield plate," and in other cases to discontinue the use of such descriptions as quadruple plate, triple silver plate and Dutch plate. The Committee is deliberating as to the best means of suppressing a practice adopted by unscrupulous traders of offering for sale very low-grade cutlery branded with high-sounding laudatory descriptions, such as "Best Sheffield Cutlery," "Superior Sheffield Cutlery," and the like. The Committee states that every endeavour will be made to put an end to this reprehensible practice.

Steel Pit Props.

A report of much interest to both coal and steel circles has just been issued by the Safety in Mines Research Board, in which the general adoption of self-adjusting steel pit props is recommended. The Board recently conducted an investigation into the support of underground workings in the East Midland coalfield, which comprises Yorkshire, Nottinghamshire, and part of Derbyshire. The report states that, in a coalfield where all the face supports are drawn, it might be expected that more use would be made of steel props. A tubular steel prop has, after numerous experiments, been adopted by the Butterley Company, Ltd., at eleven collieries in Derbyshire and Nottinghamshire, and the members of the Research Board state that they are very favourably impressed by the results obtained with this prop. They give a number of figures showing that there are fewer accidents of all kinds with steel props than with wooden ones. One striking statement is that in stalls where the steel prop has been in use, only one reportable accident—non-fatal—due to a fall of roof has occurred during more than a million man-shifts worked since the adoption of the prop eight years ago. The report adds that steel arching is being extensively used with great success on main haulage roads in at least two mines in Nottinghamshire. It is not put in on account of excessive pressure or squeeze, but because it shows a greater effective area for a given size of road, as well as complete freedom from falls and repairs so long as it is erected in more or less settled ground. The conditions in this coalfield do not, as a rule, warrant the use of steel arching on a large scale, but the Research Board recommends that for haulage roads that are required to last for many years its advantages should receive serious consideration.

Thorne Colliery's New Railway.

As a result of a meeting between the representative of Pease and Partners, Ltd., and the Goole Chamber of Commerce and Shipping, some interesting particulars have been made public with regard to the firm's project for the construction of a private railway from its colliery at Thorne Moorends to Old Goole, a distance of 5 miles, and a coaling wharf about half a mile below the entrances from the Ouse to Goole docks. It was mentioned that at the proposed wharf it would be possible to accommodate and load two steamers at the same time.

A Bridge Hold-up.

The proposal to reconstruct the toll bar bridge at Thorne is at the moment held up, a deadlock having arisen. At a meeting of the Thorne Rural Council last week, a letter was received from the County Highways Committee, stating that it could not advise the County Council to amend the terms which were tentatively agreed with the general manager of the Navigation Company. It was decided to recommend the County Council and the Navigation Company to agree to the matters in dispute being settled by arbitration.

Electricity Progress.

A large scheme of electrical extension is to be undertaken by the Nottingham City Council, which has decided upon an expenditure of £150,000 for the purpose. Thanks to a linking-up of the electricity works of Huddersfield and those of Halifax, both towns are now free from apprehension of any long or serious stoppage of electric supply. The scheme has just been completed, and during the past few days satisfactory tests have been made, under which each station has supplied both towns with current alternately.

NORTH OF ENGLAND.

(From our own Correspondent.)

Brighter Shipbuilding Outlook.

SHIPBUILDING prospects on the North-East Coast for the present year have been further improved by the placing of additional orders, and when more adequate supplies of material are available within a few weeks, the majority of the yards will enter upon several months' full employment. On the Tyne, Palmer's Company has about twenty vessels to build, and Armstrong, Whitworth and Co., Swan and Hunters, and Hawthorn and Leslie's also have ships to lay down. The prospects of the Wear shipbuilding trade are appreciably improved by the decision of William Gray and Co., Ltd., of Hartlepool, to reopen their yard at Pallion, where the firm intends to build three 8000-ton vessels. All three ships, which will be approximately 400ft. in length, are for British owners. The reopening of the yard—one of the most up-to-date in the country—will further increase the activity at Pallion, for the adjoining yard of Messrs. Short Brothers has several orders on hand. The Wear yards have now about twenty-six orders to be going on with, a number which exceeds the whole of last year's output. There is also a fair amount of activity on the Tees, the Furness Shipbuilding Company having enough orders in hand to keep its Haverton Hill yard in full activity over the next two years.

Cleveland Iron Trade.

Output in the Cleveland pig iron trade is gradually overtaking consumption, and some attempt is now being made by makers to implement the heavy arrears of deliveries under pre-strike contracts. Some of the makers, in fact, are now in a position to give delivery within a few days of an order being placed. Business, however, continues on quiet lines. Probably the time is not far distant when Cleveland will be seeking foreign orders, but present prices are regarded as prohibitive in European markets, and it is probably the belief that a fall in values will take place which is keeping home consumers off the market. Cleveland pig iron prices are still 12s. 6d. per ton above pre-strike figures, so that there is ample room for a fall. The difficulty is that coke is as dear or even dearer than ever. Before the coal strike good Durham blast-furnace coke could be delivered at 18s. to 19s. per ton; now it is 26s. per ton, and quite firm at that price. There seems to be no justification for such a rise, but the market shows no signs of weakening, and so long as the supply of coke continues to be inadequate for the industrial needs of the district, it may be possible to maintain the price. But it is certainly not in the best interests of the iron trade, which is utterly dependent upon cheap and abundant supplies of fuel. There appears to be a very marked scarcity of No. 1 Cleveland foundry iron, and the price has been advanced to 87s. 6d. per ton. No. 3 G.M.B. Cleveland is unchanged at 82s. 6d.; No. 4 foundry at 81s. 6d.; and No. 4 forge at 80s. 6d. for home delivery, export prices being 6d. per ton more.

Hematite Pig Iron.

There is no material change in the East Coast hematite pig iron trade. Makers have little iron to sell, but the demand is also limited, chiefly by the fact that foreign buyers are not prepared to pay the present prices. However, a great proportion of the output is absorbed in the local steel works, and makers have no difficulty in disposing of the rest at 90s. per ton for prompt delivery. It is significant, however, that buyers are not buying forward to any extent, and makers are offering a reduction to attract forward business.

Ironmaking Materials.

Although very little business is being done in the foreign ore trade, deliveries under contracts are on a large scale. Best Rubio ore is nominally at 22s. 6d. per ton, c.i.f. Tees.

Manufactured Iron and Steel.

Manufacturers of most descriptions of finished iron and steel are heavily sold over the next six months, and though works in operation are running at utmost capacity, consumers' requirements are not being fully met. The pressure for deliveries of shipbuilding materials is very great, work at some of the yards being held up until they are at hand. Contracts, however, are being worked off at a more rapid rate than new business is booked, and although there is no anxiety about the immediate future, steel makers would welcome more business to replace orders on which they are now engaged. The galvanised sheet trade is very quiet, and prices continue to droop, £15 5s. per ton being now quoted for 24 gauge. Other prices are unchanged.

The Coal Trade.

The coal export trade upon which the collieries of Northumberland and Durham chiefly depend is not yet what it should be, but it is moving in the right direction. The latest figures of shipments are very encouraging and are improving. The production at the collieries is better, and there are fewer men employed than before the stoppage last year. If the demand were as good as the possible output, we should see the aggregate loadings approximate to the peak years. But that is not yet, for pits in Northumberland and Durham are frequently compelled to register idle days for want of trade. Most of the exporters, however, are doing a fair business for immediate or early delivery, and this accounts for the heavy ship-

ments of the last week or two. There is still a wide margin between owners' and buyers' ideas of values, and consumers postpone orders as long as possible, being content to cover their urgent requirements. Steam coals are plentiful, but fitters will not budge from their decision to regard recent prices as rock bottom. Best Northumberland steams stand at 17s. 3d. direct, and through contractors at 16s. 9d. Best Durham steams are holding to 18s. to 19s., and Tyne primes 16s. 6d. to 16s. 9d. For steam smalls the position is disappointing, trade being very slow. Ordinary and best brands are offered at 10s. to 10s. 6d., and Tyne specials at 11s. The gas coal trade moves on fairly active lines, and values are firmly held at 18s. to 18s. 6d. for best Durham qualities, and secondary kinds at 15s. 9d. to 16s. 3d. The bunker coal trade position is not strong, and supplies offer abundantly for ordinary grades at 16s. to 16s. 6d. There is a good demand for coke, and although production is increasing it is not catching up to the full general demand, and the tone is firmer. Gas coke at 23s. to 23s. 6d. is scarce. Patent foundry cokes are steady at 23s. to 26s.

SCOTLAND.

(From our own Correspondent.)

Proposed Three-Shift Day in Clyde Shipyards.

REPRESENTATIVES of the Clyde District officials of the United Society of Boilermakers and Iron and Steel Shipbuilders have had a conference with the employers on a proposal to institute a three-shift day in Clyde yards. The first shift would be from 6 a.m. until 2 p.m.; the second from 2 p.m. until 10 p.m.; and the third from 10 p.m. until 6 a.m.; so that, apart from intervals for meals, work would proceed continuously. In favour of the proposal it is stated that if it was put into operation the men now unemployed would be absorbed more rapidly than under the present system, and that the three-shift system would almost entirely eliminate overtime working. The matter is under consideration by the Clyde Shipbuilders' Association. So far only the boilermakers' officials have approached the employers, and if the plan is considered to be advisable and practicable by the Shipbuilders' Association it will have to be laid before all the shipyard unions.

More Blast-furnaces Re-lit.

Four blast-furnaces at the Clyde works of James Dunlop and Co. have been re lit. Two of them will produce hematite and two foundry quality. Wm. Baird and Co. also intend to re-light another furnace at Gartsherrie.

Steel.

So far as new business is concerned the market is quiet. Meanwhile, the majority of the works are fully engaged on old contracts, and many are unable to give deliveries quickly enough to satisfy customers, especially those awaiting supplies of sections and plates. The demand for sheets is not quite so active. Prices, on the whole, are unchanged, boiler plates being £11 home or export; ship plates, £8 7s. 6d. home, and from £8 to £8 5s. export; and sections, £7 17s. 6d. home, and from £7 10s. to £7 15s. per ton for export.

Large Steel Output.

It is reported that David Colville and Sons, of Motherwell, have been exceptionally busy at their Clydebridge Steel Works, Cambuslang. The firm has inaugurated night as well as day shifts, and in the course of one week recently it rolled about 5600 tons at its new large plate mill and actually finished about 5000 tons. The materials were intended mostly for shipbuilding and structural work.

Iron.

The bar iron works are moderately busy, but could easily undertake more work in all departments. Bar iron is £11 15s. per ton for home delivery, and averages a similar figure for export. No increase in business has resulted from the recent reduction in the price of re-rolled steel bars. These bars are still quoted about £8 10s. per ton home and export.

Pig Iron.

Consumers of pig iron continue to purchase on a hand-to-mouth principle, and outputs are mostly sufficient for all demands. Some makers still find difficulty in securing the standard in foundry qualities. Hematite and No. 1 foundry are unchanged in price, but No. 3 foundry has been quoted down to 90s. per ton and lower.

Coal.

The position in the coal market is hardly satisfactory; neither home nor export buyers are disposed to commit themselves ahead, and business, especially in the export section, is of a very hand-to-mouth variety. Outputs are only moderate, but even then the collieries find difficulty in disposing of their fuels, and anyone with a good order to place can gain concessions in price in practically all qualities. The only exceptions are Lanarkshire ells and splints and Fifeshire (Cowdenbeath-Lochgelly) steams. Aggregate shipments during the past week amounted to 282,960 tons, against 232,235 tons in the preceding week and 234,199 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

COAL exports from South Wales last week showed a welcome improvement, and were, in fact, in the region of normal figures. The total was 516,000 tons, which was rather over 100,000 tons more than for the week ending February 4th. Considering the supply of tonnage available the total can justly be regarded as very satisfactory, though it must not be thought that the conditions in the trade have reached a normal state. They are, in fact, still unsettled, and a considerable number of workmen has yet to be absorbed in the industry. The demand from abroad is somewhat spasmodic, but still there are encouraging signs, and doubtless the fact is being realised to an increasing extent that coal values are getting to the lowest limit—if, indeed, in some instances they have not touched bottom. It was mentioned last week that a freight contract had been fixed up for about 100,000 tons of coal for South America. As a matter of fact, it is understood that the total quantity of sized coals which has been sold to one of the leading South American electricity works for delivery from May to the end of the year runs to close upon 200,000 tons, of which Gueret, Llewellyn and Merrett, Ltd., of Cardiff, have contracted for by far the greater proportion. There are several other important orders pending, but it is reported that the Tredegar Associated Collieries have secured the contract for about 30,000 tons of steam coals for the Norte Railways of Spain, and the Algerian State Railways are in the market for 32,000 tons of bituminous sized coals for delivery from March to the end of the year. It is also now officially announced that the Egyptian State Railways are calling for tenders for further supplies of coal. The first adjudication takes place at Cairo on March 1st for 100,000 metric tons for delivery over March and April, and further adjudications take place on May 1st and July 1st for two further lots of 100,000 tons each. It would be scarcely correct to state that the inquiry from abroad is back to normal proportions, as the demand for current shipment is still on the quiet side. At the same time, it is slowly improving.

Coals for France.

South Wales coalowners are feeling somewhat anxious concerning the proposed action of the French Government, which, it is understood, is introducing at the end of the present week provisions of a new financial Bill which involves an increased import duty on certain commodities, embracing anthracite coals and patent fuel. The matter is calculated to be such an important one to this district that the Commercial Committee of the South Wales Coalowners' Association has had it under consideration, and has, in fact, communicated with the Secretary of Mines, asking for leave for a deputation to wait upon him, so that it could discuss with him the steps that should be taken without delay to protect the Association's interests. In the course of its letter to the Secretary of Mines, the Commercial Committee states that it is understood that included in the duties will be one of 5 per cent. on the c.i.f. value of all anthracite coals and an increase from 2f. to 3f. per ton on patent fuel. The effect of the additional impost on anthracite coals would be disastrous to the collieries producing those coals and would react in a general way on the coalfield as a whole. Practically the whole output of anthracite in the United Kingdom is mined in South Wales, the annual output in this district being between 5 and 5½ million tons per annum. The quantity shipped from the Bristol Channel ports to France approximates 1½ million tons per annum, which represents 50 per cent. of the total shipments of anthracite coals to all destinations. As regards patent fuel, practically the whole production is exported. Briquettes are made from small coals, for which no other markets are in the ordinary way available, and a decreased production of briquettes therefore causes a lessened demand for small coals, which means that collieries lose time, due to their inability to dispose of such coals. The Secretary of Mines has intimated his willingness to meet a deputation this week.

Coalfield Items.

The trouble at the Gwaun-cae-Gurwen Collieries affecting chiefly the hauliers has been settled, largely owing to the fact that the chairman of the company, Sir David R. Llewellyn, met the men's leaders himself at the end of last week. It is hoped that from now on a different attitude will be in evidence, and that better relations generally will prevail. The personal touch brought to bear upon the situation has had beneficial results. Another settlement which has been arrived at is that affecting the workmen at the Risca Collieries, of which the new proprietor is the Ocean Coal Company. Hopes are entertained that before long 2500 men will be re-employed. The terms agreed upon are those applicable to the whole industry and were determined when the coal stoppage throughout the country came to an end. This settlement, however, does not apply to the Nine-Mile Point Collieries, which belong to the same company. As regards developments, it is reported that Messrs. Guest, Keen and Nettlefold contemplate important developments in the Cwmgorse Valley. This work would have been taken in hand some time ago but for the coal stoppage. On the occasion of the cutting of the first sod of the new pits, a new turbine in connection with the electric installation at the Gwaun-cae-Gurwen Collieries, which has cost between £25,000 and £30,000, will be formally put to work.

Ship-repairing Industry.

Employment in the ship-repairing industry maintains a very fair level, but the most satisfactory feature of the news regarding this industry is the fact that the Committee of the Boilermakers' Society, which had in hand negotiations with the employers on the question of revised working conditions, has been instructed to resume these negotiations, which were broken off about a week ago. The result is that hopes are strongly entertained that at last something will come of the discussions, and that the employers will be enabled to quote for orders with a better prospect of securing them in competition with other repairing undertakings in the country and abroad.

Current Business.

There has not been much change in the coal market since I wrote a week ago, but the tone is generally quiet for early shipment. This is due to shipping having been held up by bad weather and fog. The result is that arrivals of expected tonnage have been very disappointing, and at most of the docks there were vacant berths in the early part of this week. This weakness is likely to be of only a temporary character, as a fair amount of chartering has recently taken place, and when tonnage does come along there should be a fair amount of loading pressure. Meanwhile values are somewhat irregular, but coalowners are stiffening their attitude towards making further material concessions. Small coals are steady, as the better descriptions especially are none too plentiful.

CONTRACTS.

HOLDEN AND BROOKE, Ltd., of Manchester, have recently received an order for thirty of their "Leinert" type water meters for boiler feed measurement, of which they are the sole licensees and manufacturers in Great Britain.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has obtained an order for the supply of Mazda electric lamps from the Pacific Steam Navigation Company, of Liverpool, for the whole of the latter's requirements during the year 1927.

WM. SIMONS AND CO., Ltd., Renfrew, have received an order for a powerful cutter and drag suction hopper dredger for the port of Chittagong, India. The dredger will be constructed under the direction of Messrs. Rendel, Palmer and Tritton, of Westminster, London, the consulting engineers for the Port Trust.

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Ltd., has received an order from the Metropolitan-Vickers Electrical Company, Ltd., for eighty-two electrically driven air compressors, type C.M. 38, for the supply of compressed air to the brake equipments on electric locomotives of the Great Indian Peninsular Railway.

THE ELECTRIC FURNACE COMPANY, Ltd., of 17, Victoria-street, London, S.W. 1, has, since the beginning of February, received orders from British firms for fifteen 75 kilovolt-ampère Ajax-Wyatt electric induction furnaces for melting brass. These furnaces are, in the aggregate, to be capable of melting about 50,000,000 lb. of brass per annum.

CLAYTON WAGONS, Ltd., of Lincoln, has received from the New Zealand Government an order to manufacture a light geared steam locomotive, embodying the "Clayton" patented power unit. The same firm has also received from the Crown Agents for the Colonies an order for the construction of three "Clayton" patented railway steam cars for service on the Ceylon Railways. In addition it has received an order from the Birmingham Corporation Cleansing Department for a 3½-ton "Clayton" electric wagon fitted with an all-steel refuse collecting body.

EDWARD BENNIS AND CO., Ltd., of 28, Victoria-street, Westminster, S.W. 1, have received an order for the complete equipment of mechanical chain-grate stokers for Stirling boilers and mechanical coal-handling plant for the new generating station of the city of Coventry. This plant will comprise, in addition to the stokers, which are to be sixteen in number and of the induced draught type, each grate being 9ft. wide by 17ft. long, two barge unloading telphers, a hopper weighing machine, U-link chain conveyors, a jib crane and track, a rotary truck tipper, and a weighbridge and accessories.

RANSOMES AND RAPIER, Ltd., of Ipswich and 32, Victoria-street, Westminster, London, S.W. 1, have received orders to proceed with the manufacture of the following:—(*a*) Lloyd Barrage, Sukkur: 165 canal head regulator gates, with the necessary built-in parts and regulating machinery, for the fifty-five openings of the seven main irrigation canals which will take off from the river Indus, immediately above the barrage; (*b*) Kaffir Bulin, Egypt: ten roller type gates for the five openings of the new Kaffir Bulin Regulator, which is to replace the old regulator of the same name, situated approximately midway between Cairo and Alexandria. Each of these openings will be provided with two gates having a span of 5 m. and a combined depth of 5·7 m. Two pairs of steel double-leaf lock gates, each 12 m. span by 5·7 m. deep, complete with all valves and operating gear, and also lock filling sluices in the side walls of the lock; and one swing bridge, 12 m. clear span and overall length of 22·5 m., with a clear width of roadway equal to 5 m.

CATALOGUES.

THOMAS AND BISHOP, Ltd., 37, Tabernacle-street, E.C. 2.—A treatise on "Flexo" refractory cements.

W. E. BURNAND AND CO., 66, Shoreham-street, Sheffield.—Leaflet illustrating a 200-kilowatt turbo-generator.

RUSTON AND HORNSBY, Ltd., Lincoln.—Publication No. 5032, entitled "Cheapest Electricity—How to Obtain it."

O. N. BECK, 11, Queen Victoria-street, E.C. 4.—Leaflet describing the uses of the "Hurricane" electric hand blower.

G. CUSSONS, Ltd., Manchester.—Booklet describing in detail the "Scholes" bomb for solid and liquid fuel calorimetry.

CROMPTON AND CO., Ltd., Chelmsford.—Descriptive leaflet A12 on the three-phase "Tru-Wat" auto-synchronous motors.

EXHIBITION OF STREET LIGHTING APPLIANCES AT BRIGHTON.—In connection with the forthcoming annual general meeting and conference of the Institution of Public Lighting Engineers, to be held at Brighton on September 12th, 13th, 14th, and 15th next, it is proposed to hold an Exhibition of Street Lighting Appliances—electric, gas, or other illuminants. Firms desiring to take part should make application to Mr. Alex. C. Cramb, president-elect of the Institution, Electric House, 38, High-street, Croydon, Surrey, stating their requirements as to floor space and if they require a supply of electricity or gas in connection with their exhibits.

DIESEL ENGINE USERS ASSOCIATION.—At the February meeting of the Diesel Engine Users Association, which was held on the 4th instant, the newly elected president, Mr. Geoffrey Porter, Assoc. M. Inst. C.E., made an interesting statement concerning the growth of the Association during the period which had elapsed since his first term of office as president—1916–1917. The total brake horse-power of heavy oil engines represented in the membership of the Association at the present time was, he said, over 200,000 and was nearly ten times what it had been in 1916. A very noticeable feature was the great increase in the individual capacity of heavy oil engines which makers were now able to offer with every confidence to prospective purchasers. As recently as 1916 an individual capacity of 80 brake horse-power per cylinder had been the usual order of things, whereas at the present time one heard of engines being installed for marine purposes of 1250 brake horse-power per cylinder, and in the case of the nine-cylinder oil engine generator set at Hamburg the power of each cylinder was over 1600 brake horse-power. He thought it could safely be said that the Diesel engine was a perfectly reliable form of prime mover up to the largest sizes, and he had no doubt that as an increasing amount of experience was gained with the larger sizes of cylinder still further progress and development would be made.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 10 0	—
No. 1 Foundry	4 15 0 to 4 17 6	—
No. 3 Foundry	4 11 6 to 4 14 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 10 0	4 10 0
No. 1	4 11 0	4 11 0
Cleveland—		
No. 1	4 7 6	4 7 6
Silicious Iron	4 7 6	4 7 6
No. 3 G.M.B.	4 2 6	4 3 0
No. 4 Foundry	4 1 6	4 2 0
No. 4 Forge	4 0 6	4 1 0
Mottled	4 0 0	4 0 6
White	4 0 0	4 0 6
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	— . ..	—
North Staffs. Forge	4 0 0	—
„ „ Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	4 0 0 to 4 2 6	
„ Forge	3 13 0	—
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 5 0	
Forge	3 18 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 5 0	—
No. 4 Forge	—	—
Basic	4 0 0 ..	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 17 6 (a) ..	—
	5 0 6 (b) ..	—
	5 4 0 (c) ..	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 15 0	—
Best	—	—
N.E. COAST—		
Common Bars	12 5 0	—
LANCS.—		
Crown Bars	11 15 0	—
Second Quality Bars	10 15 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	11 15 0	—
Best Bars	13 10 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	12 0 0	—
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 0 0	—
Gas Tube Strip	13 5 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ¼in. and up	8 7 6 .. £8 0 0	to 8 5 0
Sections	7 17 6 .. £7 10 0	to 7 15 0
Steel Sheets, under 3/16in. to ¼in.	12 5 0 to 13 5 0	
Sheets (Gal. Cor. 24 B.G.)	— £16 0 0	to 17 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 10 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0†	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0†	
MANCHESTER—		
Bars (Round)	9 0 0	—
„ (Small Round)	9 0 0	—
Hoops (Baling)	11 0 0	11 0 0
„ (Soft Steel)	10 15 0	10 15 0
Plates	8 17 6 to 9 0 0	
„ (Lancs. Boiler)	11 10 0	—
SHEFFIELD—		
Siemens Acid Billets	11 0 0	—
Bessemer Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	7 15 0	—
Hoops	12 0 0	—
Soft Wire Rods	11 0 0	—
MIDLANDS—		
Small Rolled Bars	8 15 0 to 9 0 0	
Billets and Sheet Bars	7 0 0 to 7 5 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	15 7 6	—
Angles	7 17 6 to 8 0 0	
Joists	7 17 6 to 8 0 0	
Toes	9 0 0	—
Bridge and Tank Plates	8 17 6 to 9 2 6	
Boiler Plates	11 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/9 to 20/-
Block Tin (cash)	304 0 0
„ (three months)	293 0 0
Copper (cash)	54 10 0
„ (three months)	55 0 0
Spanish Lead (cash)	27 17 6
„ (three months)	28 7 6
Spelter (cash)	30 0 0
„ (three months)	31 3 9
MANCHESTER—	
Copper, Best Selected Ingots	61 2 6
„ Electrolytic	61 5 0
„ Strong Sheets	84 0 0
„ Tubes (Basis Price)	lb. 0 1 0½
Brass Tubes (Basis Price)	lb. 0 11½
„ Condenser	lb. 0 1 1½
Lead, English	29 12 6
„ Foreign	28 5 0
Spelter	30 2 6
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
„ „ 6 p.c. to 8 p.c. „	£22 0 0	7/3
„ „ 8 p.c. to 10 p.c. „	£20 17 0	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 2 6	11/6
„ „ „ 1 p.c. „	£42 5 0	15/-
„ „ „ 0·70 p.c. carbon	£54 0 0	17/6
„ „ „ carbon free	1/5d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£16 for home, £16 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 7 6 scale 5/- per unit	
„ „ 75 p.c.	£18 10 0 scale 6/- per unit	
„ Vanadium	14/6 per lb.	
„ Molybdenum	5/3 per lb.	
„ Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Cobalt	8/9 per lb.	

FUELS.

SCOTLAND.

(Prices not stable).

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	16/3
„ „ Ell	17/-
„ „ Splint	17/6 to 19/6
„ „ Trebles	19/-
„ „ Doubles	17/-
„ „ Singles	16/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	17/6
„ „ Jewel	19/-
„ „ Trebles	19/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	14/- to 15/9
Screened Navigation	22/9
Trebles	19/- to 20/-
Doubles	16/6 to 17/-
Singles	15/3
LOTHIANS—	
(f.o.b. Leith)—Best Steam	15/3
Secondary Steam	14/6
Trebles	19/-
Doubles	17/-
Singles	15/-

ENGLAND.

(8) N.W. COAST—	
Steams	27/6
Household	*No quotation*
Coke	31/6
NORTHUMBERLAND—	
Best Steams	17/- to 17/3
Second Steams	15/6 to 16/-
Steam Smalls	11/-
Unscreened	15/6 to 16/-
Household	23/- to 30/-
DURHAM—	
Best Gas	17/- to 18/-
Second	15/6 to 16/-
Household	23/- to 30/-
Foundry Coke	24/- to 25/-

	Inland.	
SHEFFIELD—		
Best Hand-picked Branch	40/-	—
Best Selected House Coal	34/- to 35/-	—
Barnsley Best Silkstone	30/- to 32/-	—
Derbyshire Best Brights	30/- to 32/-	—
„ „ House	28/- to 30/-	—
„ „ Large Nuts	26/- to 28/-	—
„ „ Small	18/- to 21/-	—
Yorkshire Hards	19/- to 21/-	—
Derbyshire Hards	19/- to 21/-	—
Rough Slacks	12/- to 12/6	—
Nutty Slacks	8/6 to 9/6	—
Smalls	3/- to 6/-	—
Blast-furnace Coke (Inland)	20/- to 25/- at ovens.*	
„ „ (Export)	f.o.b.	26/- to 27/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	22/6 to 23/-
Second „ „	21/6 to 22/-
Best Dry Large	21/6 to 22/6
Ordinary Dry Large	20/6 to 21/-
Best Black Vein Large	21/9 to 22/3
Western Valley Large	21/6 to 21/9
Best Eastern Valley Large	21/- to 21/6
Ordinary „ „	20/6 to 21/-
Best Steam Smalls	14/6 to 15/6
Ordinary „	12/- to 14/-
Washed Nuts	20/- to 24/6
No. 3 Rhondda Large	26/- to 27/6
„ „ Smalls	18/- to 19/-
No. 2 „ Large	21/- to 22/-
„ „ Through	18/- to 19/-
„ „ Smalls	13/- to 14/-
Foundry Coke (export)	40/- to 45/-
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	27/6 to 28/-
Pitwood (ex ship)	31/- to 31/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	35/- to 36/-
Seconds	29/- to 32/6
Red Vein	27/6 to 29/-
Machine-made Cobbles	42/6 to 45/-
Nuts	50/- to 55/-
Beans	44/- to 46/-
Peas	22/6 to 25/-
Breaker Duff	9/- to 9/6
Rubbly Culm	13/6 to 14/-
Steam Coals:	
Large	22/- to 23/-
Seconds	21/6 to 22/-
Smalls	11/- to 13/-
Cargo Through	17/- to 18/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayreshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o b. for export. (9) Per ton f.o.b. † Latest quotations available.

(a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. * Open market price. Special price for pig iron producers, 19/- per ton at ovens.

French Engineering Notes.

(From our Correspondent in Paris.)

Work for Unemployed.

THE Government is doing all it possibly can to avoid paying dole to the unemployed and prefers to spend money on providing work of national importance. The matter has been investigated by the newly formed Conseil National Economique, which is of the opinion that there is nothing yet to show that the crisis is likely to be of long duration, although, if the unemployment trouble should become more serious, it is probable that the Government plan of public works will be put in hand. There is some hesitation about doing that on account of the necessity of procuring huge credits at a time when it is indispensable to effect economies in every direction. On the other hand, the Conseil Supérieur des Chemins de Fer has decided to seek authority to increase the issue of railway debentures this year, so that an additional 171 million francs may be devoted to the construction of rolling stock, and a further 185 million francs for building construction and permanent way improvements and extensions. It is hardly likely, however, that orders for rolling stock will be given out at an early date, as nothing can be done until the companies have settled upon types of vehicles which are to be accepted as a standard, but steps are being taken to hasten this standardisation as much as possible. Nevertheless, fair numbers of orders for locomotives and wagons have been distributed recently. The necessity of providing employment is hastening forward the work of equipping goods trains with continuous brakes. That matter has been delayed by the failure of the countries concerned to adopt any particular type of brake and also by the heavy cost of equipping 400,000 trucks, which cannot be done except with the aid of German brakes supplied on account of reparations. As France proposes the modified Westinghouse brake and Germany and some other countries have long been using the Kunze-Knorr brake, negotiations were started some time ago between the Westinghouse Company and the makers of the K.K. brake, with a view to arranging that each should have its prescribed territory, but they fell through. There seems to be little doubt now that the French Government will endeavour to arrange with Germany for the supply of K.K. brakes on account of reparations, and the manufacture of accessory fittings will provide a considerable amount of work in this country. The equipment of the trucks is to extend over a period of five years.

Coal Production.

The production of coal in France during 1926 reached a total of 52,477,972 tons, as compared with 48,033,564 tons in the previous year. The amount is nearly 12,000,000 tons in excess of the pre-war production. The result has been achieved despite the operation of the eight-hours' day, which has diminished appreciably the individual output, and it has only been rendered possible by the modern equipment of the collieries in the Nord and the Pas de Calais and by the considerable importation of labour from Poland and elsewhere. The reconstruction of the collieries permitted of the putting down of the most efficient plants, while everything has been done by organisation to reduce costs to a minimum. All the collieries are electrified throughout. Coal-cutting machines are employed wherever possible. Still, it is declared that the lower individual production resulting from the application of the eight hours' day has increased the cost of coal per ton at bank, and coalowners are unable, so far, to make any appreciable reduction in prices. The increased output has the effect of reducing the imports of coal, which amounted in 1926 to 15,402,828 tons, as compared with 18,396,417 tons in the previous year. This may be partly attributed to the miners' strike in Great Britain, the imports of British coal amounting to only 4,156,333 tons, but as that figure includes consignments during the latter half of the year, it is obvious that some of the total must have been foreign coal carried on British ships. The imports from Germany amounted to 7,744,169 tons. The production of coke at French collieries in 1926 was 3,767,400 tons, as compared with 3,064,918 tons in 1925 and 2,267,464 tons in 1924.

South American Air Service.

After running a successful air service between Toulouse and North Africa, with extensions to Casablanca and Dakar, for some years past, the Latécoère Company is arranging to start a service between Paris and Buenos Aires in September next. It is reported that a contract has been signed by the company and the Argentine Government for the transport of mails during the next ten years. The service will be started somewhat modestly by means of seaplanes between Dakar and the Cape Verde Islands, and passengers and mails will then be taken by special fast boats to the Isle of Fernando Noronha, a distance of 2250 miles, where they will again be embarked upon seaplanes for Brazil and complete the journey to Buenos Aires in aeroplanes. The total distance of 8500 miles from Paris is expected to be covered in 9½ days. It is hoped that next year the whole of the journey will be accomplished by seaplanes and aeroplanes in four days, but as such an organisation would require about 200 single engine machines and 40 multi-engine seaplanes, it is by no means certain that the funds necessary for the construction of such a great air fleet will be obtainable in time. Meanwhile, the report that a contract has been entered into by the Argentine Republic with a French company has aroused strong feeling in Spain, where the Spanish-German company, with the support of the Spanish Government, had hoped to secure from the Argentine Republic a monopoly of the air traffic between Europe and Buenos Aires. At a conference held in Madrid some time ago the South American delegates, while offering concessions to Spain, to permit of the Spanish German company organising a service of Zeppelin airships and German seaplanes, which were to be constructed eventually in Spain, refused to grant a monopoly, and Lieutenant-Colonel Herrera, who is at the head of the Spanish-German company, declares that measures will be taken to prevent the French machines employed in the new service from passing over Spanish territory. This is the first conflict between French and German interests in the race to create international air services.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

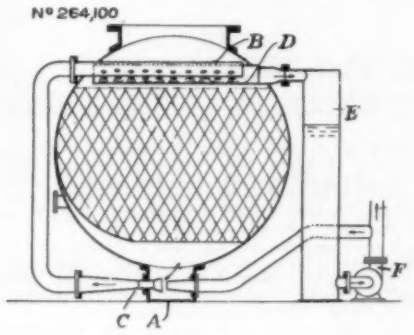
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

CONDENSERS AND FEED-WATER HEATERS.

264,100. September 28th, 1926.—SURFACE CONDENSERS, P. H. Müller, 29, Rumannstrasse, Hanover, Germany.

This invention virtually amounts to the subjection of the condensate produced by a surface condenser to the warming action of the steam entering the condenser, so as to provide as hot a feed water as is possible. For this reason the condensate

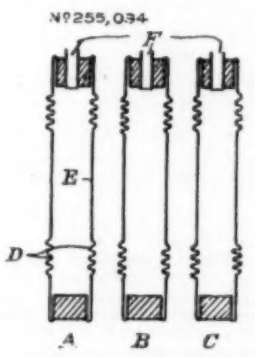


is raised from the sump A to a spray pipe B by means of the ejector C. The spray, after meeting the incoming steam, is collected in the trough D and goes to the stand-pipe E, from which it is drawn by the extraction pump F. A certain proportion of the water delivered by the pump is diverted to operate the ejector.—*January 13th*, 1927.

ELECTRICAL APPLIANCES.

255,034. June 12th, 1926.—IMPROVEMENTS IN OR RELATING TO APPARATUS FOR FEEDING OIL TO HIGH-TENSION CABLES, Pirelli and Co., of Bicoca Works, near Milan, Italy.

This specification describes a variable capacity reservoir for feeding oil into high-tension electric cables. The reservoirs consist of one or more cells A B C, provided with flexible walls, so as to permit of the volume of the cell or cells varying with a variation of the pressure of the oil in the cable. Corrugations

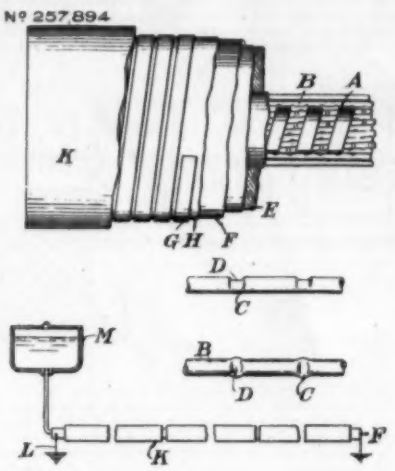


are provided at D, so that when the pressure on the outer or inner faces of the walls or diaphragms E increases the respective volumes of the cells undergo an alteration. By means of a passage F oil can enter or leave the space between the diaphragms of each element, the passage F being arranged to communicate with a common pipe communicating with the interior of the cable sheath. An alternative arrangement is described.—*January 13th*, 1927.

TRANSMISSION OF POWER.

257,894. July 7th, 1926.—IMPROVEMENTS IN OR RELATING TO HIGH-TENSION ELECTRIC CABLES, Pirelli and C., of Bicoca Works, near Milan, Italy.

This specification describes a high-tension cable, in which the strands of the conductors are supported by a hollow metallic core, through which oil flows and impregnates the insulation that surrounds the conductors, the insulation being in turn enlcosed by a sheath of soft metal, such as lead. A metal ribbon A is used, and it is wound to form a helix. With a core constructed in this manner the passage-way for the oil may be made substantially larger in cross-section for the same outside diameter of the cable. Moreover, the frictional resistance to the flow of oil is very greatly reduced, owing to the practical elimination of whirls and eddies between adjacent turns of the helix. Bare wire strands B are wound on the core and these wires carry the current. Two layers of these wires are shown. These strands are wound round the core to form a spiral of long pitch, the strands of one layer crossing those of the other at an angle. The strands are tightly wound in layers about the core and in contact with one another. The copper wires or strands B are also slightly deformed, so that a large number of small passages is formed between adjacent wires of the same layer. Bumps C and depressions D on the wires provide openings through which the oil can pass. Tightly wound around the conductor is a body of paper E, which is impregnated with oil from the central passage of the core, and surrounding the paper is a lead sheath F, which prevents the escape of oil. To prevent the lead sheath bulging, it is wrapped with a thin copper tape, and to prevent the tape cutting into the lead sheath a few layers of hard paper are provided, as shown at H. A lead covering K surrounds the cable, and it is in metallic and electrical contact with the binding metal tape G. The lead sheath is made continuous, so as to prevent the escape of oil, and it is connected to earth by a connection L. The casing K is, however, made discontinuous, and is not earthed by any special means, the object being to prevent

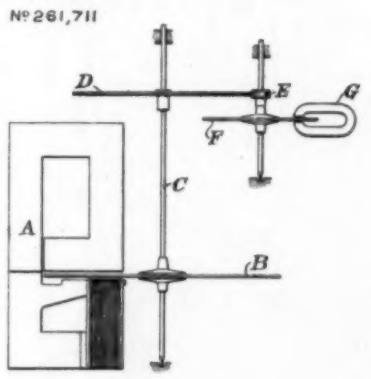


the formation of local eddy currents. M is a reservoir for feeding oil into the cable. The lead sheath F is earthed at both ends of the cable.—*January 6th*, 1927.

MEASURING AND TESTING INSTRUMENTS.

261,711. September 1st, 1926.—APPLICATION OF A PERMANENT BRAKE TO ELECTRICITY METERS, Landis and Gyr S.A., of Zug, Canton Zug, Switzerland.

This invention relates to an application of a permanent brake to electricity meters. At least one permanent magnet acts on a separate disc which, by means of transmission gear, is connected to the driving spindle of the meter so as to be driven at a high speed. A is the driving system, B the driving disc, and C the driving spindle of the meter. On the latter is mounted a toothed wheel D, which gears with a small toothed wheel E, which is mounted on an auxiliary spindle to which a disc F is also keyed.

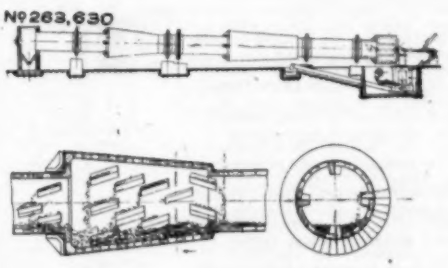


On this disc a permanent magnet G acts. As the permanent magnet G acts on a disc running faster than the driving disc B this magnet may be made considerably smaller than if it acted directly upon the driving disc B itself. This also enables the brake disc to be constructed of a material which has a suitable temperature coefficient so that the temperature error of the meter may be varied. For this purpose the disc F may consist of an aluminium alloy containing copper, silicon and iron. A number of permanent magnets G may also be arranged to act on the disc F, and the driving disc B may also be acted upon by one or more permanent magnets.—*January 6th*, 1927.

FURNACES.

263,630. January 8th, 1926.—ROTARY KILNS, J. H. Bentley, Headingly House, Misterton, Notts.

This invention is concerned with rotary furnaces for such purposes as the production of Portland cement, and aims at an increased production without addition to the length of the furnace. For this reason the calcining zone is enlarged at one or more places by conical portions, which provide a smaller angle or gradient for the travel of the material through the kiln. As a result, the material is retarded in the calcining zone,

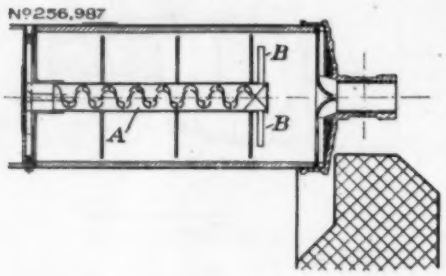


where it is subjected to the action of the hot gases, so that by the time it reaches the sintering zone where combustion of the fuel takes place its temperature is higher than usual and the final clinkering is expedited and its vitrification more quickly effected. The conical portions of the kiln may be fitted with lifters, as shown in the drawing, arranged as reverse helices in order to assist in the retardation of the material, and, if desired, lifters arranged as forward helices may be provided to transfer the material from the conical to the cylindrical portions of the kiln. —*January 6th*, 1927.

CRUSHING AND GRINDING.

256,987. August 13th, 1926.—Ball Mills, F. L. Smidth and Co. A/S, 33 Vestergade, Copenhagen B, Denmark.

Experiments have, according to the inventors, shown that an increased fineness of cement cannot be obtained without substantially decreasing the output in ball mills, because cement, when ground to a certain degree of fineness, has a strong tendency to stick to the grinding bodies, so that these are coated with

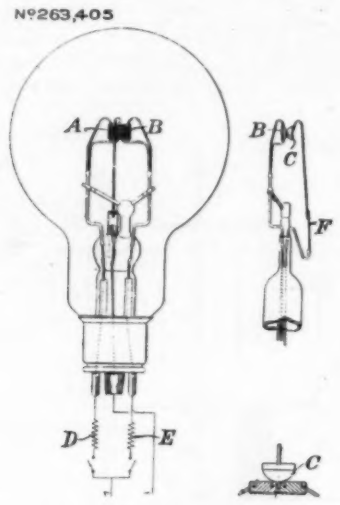


a film which considerably reduces their grinding action. This trouble is overcome in the mill illustrated by arranging a spiral conveyor A inside the drum, and providing it with scoops B B, which pick up the balls at the delivery end of the mill and return them to the feed end. In their progress along the conveyor the balls are, it is stated, automatically relieved of the coating film of cement.—*January 6th*, 1927.

LIGHTING AND HEATING.

263,405. June 19th, 1926.—An Improved Tungsten Arc Lamp, *The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C.* 2.

The object of this invention is to construct, in the simplest manner, tungsten arc lamps for much higher candle-powers than usual, that is, those of 2000 candles and more. Two or more anodes, A and B, co-operating with one cathode C, are connected in parallel, and a resistance is connected in series with each. When the lamp is in use it is possible, therefore, if the current be the

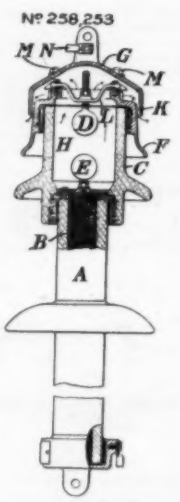


same for every arc, to maintain two or more arcs and to raise every anode to a bright white. The glass vessel is filled with inert gases such as a mixture of nitrogen and argon. When the lamp is not in operation the cathode C, which contains thorium oxide, is in contact with both the anodes. When the current is switched on, however, the cathode C is drawn away from the anodes A and B by the action of the bimetallic strip F, which is forced to bend by the action of the current.—*December 30th*, 1926.

MISCELLANEOUS.

258,253. September 3rd, 1926.—Improvements in and relating to Lightning Arresters, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C 2.

One of the main objects of this invention is to stabilise sparking conditions in a lightning arrester irrespective of variations in the weather, and this result is obtained by providing a metallic shield over the spark gap housing. The arrester described is of the oxide film type with a porcelain tube A, which contains the oxide pellets B. The tube also serves as a support for the porcelain member C, in which the sparking electrodes D and E are placed. The member C is capped with a hood composed of metal parts. The chamber H is connected with the outside atmosphere by a passage way K between the elements F and G. The electrode E is connected with the pellets B, whilst the electrode D is supported by the metal strip L, which is electrically connected to the hood element G through the element F and bolts M. The line that is to be protected is connected to the top element G of the hood in any suitable manner, as, for example, by a conductor N.—*January 6th*, 1927.



247,925. January 19th, 1926.—An Improved Method of Generating High-frequency Three-phase Currents, C. Lorenz Aktiengesellschaft, of Lorenzweg, Berlin Tempelhof, Germany.

If a high-frequency three-phase current be generated from a three-phase current of a lower frequency by means of frequency transformers, it is found that, in the case of the high-frequency current, the correct phase relation is not maintained. If a three-phase current be multiplied to three times its frequency by means of a frequency transformer, it is found that the high-frequency currents in the various phases have become co-phasal, and it is the object of this invention to enable high-frequency three-phase currents to be generated with maintenance of the correct phase relation. By means of a two-phase transformer, the frequency of a two-phase current is first raised to the desired frequency, and the high-frequency two-phase current thus obtained is transformed in any desired manner, such, for example, as by means of the Scott connection, into high-frequency three-phase current.—*January 13th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

Institution of Automobile Engineers.—Queen's Hotel, Coventry. Coventry Graduates' annual dinner. 7 p.m.

Institution of Locomotive Engineers.—The Engineers' Club, Coventry-street, London, W. 1. Annual dinner. 6.30 for 7 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Annual general meeting. Resumed discussion on "The Use and Economy of High-pressure Steam Plants," by Professors A. L. Mellanby and W. Kerr; and "The Economic Value of Increased Steam Pressure," by Mr. H. L. Guy. 6 p.m.

Institution of Municipal and County Engineers: Yorkshire District.—Town Hall, Leeds. Joint meeting with the North of England Division of the Town Planning Institute. Address on "Recent Developments in Regional Planning," by Mr. G. L. Pepler. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Paper, "Modern Concrete Construction: A Review of Recent Progress and Problems," by Mr. Leslie Turner. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "The Laws of Monetary Science," by Sir Josiah Stamp. 9 p.m.

SATURDAY, FEBRUARY 19th.

Birmingham Metallurgical Society.—Girls' High School, Dudley. Lecture, "Blast-furnace Practice," by Mr. R. P. Bethell. 7 p.m.

Institute of British Foundrymen: Lancashire Branch, Junior Section.—College of Technology, Manchester. Paper, "Pattern Making in Plaster of Paris," by Mr. C. Heggie. 7 p.m.

Keighley Association of Engineers.—Queen's Hotel, Keighley. Annual dinner. 5.45 p.m.

North of England Institute of Mining and Mechanical Engineers.—Newcastle-upon-Tyne. Resumed discussion on "The Chemical Relations of the Principal Varieties of Coal," by Professor G. Hickling. Papers, "Screening and Washing Plant at Deaf Hill Colliery," by Mr. L. F. H. Booth, and "The Economic Working of Thick Seams in New South Wales," by Mr. W. Rawling. 2.30 p.m.

MONDAY, FEBRUARY 21st.

Bradford Engineering Society.—Technical College, Bradford. "Reducing Valves," by Professor G. F. Charnock. 7.30 p.m.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. Paper, "The Straight-Eight Engine," by Mr. E. W. Sisman. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Graduates' Section meeting. Paper, "The Screw Propeller," by Mr. F. C. Johansen. 7 p.m.

Railway Club.—25, Tothill-street, London, S.W. 1. Annual general meeting and Presidential address. 7.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "Photo-elastic Measurements of Stress Distribution," by Professor E. G. Coker. 8 p.m.

MONDAY TO FRIDAY, FEBRUARY 21st TO MARCH 4th.

British Industries Fair.—Castle Bromwich, Birmingham, and White City, London. 10 a.m. each day.

TUESDAY, FEBRUARY 22nd.

Illuminating Engineering Society.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Artificial Light as an Aid to Aerial Navigation," by Mr. H. N. Green. 6.30 p.m.

Institution of Civil Engineers.—Great George-street, London, S.W. 1. Paper, "The Maramsilli Reservoir Automatic Siphon Railway," by Mr. Powys Davies.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow. Paper, "The Application of Pre-cooling by Primary Evaporation and Multiple Effect Compression to CO_2 Refrigerating Machines," by Mr. Henry Brier. 7.30 p.m.

Newcomen Society.—Institution of Mechanical Engineers, Storey's-gate, London, S.W. 1. Papers: "The Early British Railways as Seen by Marc Seguin in 1825: The Four-cylinder Locomotive Chittaprat," by Messrs. Ferdinand Achard and Laurent Seguin; "The First British Locomotives of the St. Etienne-Lyon Railway," by Mr. Ferdinand Achard. 5.30 p.m.

Sheffield Metallurgical Association.—Sheffield Metallurgical Club, 198, West-street, Sheffield. "Practical Crucible Steel Melting," by Mr. J. F. Kayser. 7.30 p.m.

WEDNESDAY, FEBRUARY 23rd.

Association of Special Libraries and Information Bureaux.—Royal Institute of British Architects, 9, Conduit-street, London, W. 1. Address on "Directory of Sources of Specialised Information," by Mr. G. F. Barwick. 6.30 p.m.

Institution of Automobile Engineers.—Birmingham Graduates' visit to the works of W. and T. Avery, Ltd., Soho Foundry, Birmingham. 2.30 p.m.

Northampton Engineering College Engineering Society.—St. John-street, London, E.C. 1. Walmsley Memorial Lecture, "Chemistry and Engineering: Fuels and the Internal Combustion Engine," by Dr. W. R. Ormandy. 4.15 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Insulin and its Manufacture," by Mr. F. H. Carr. 8 p.m.

THURSDAY, FEBRUARY 24th.

Engineering Golfing Society.—Institution of Civil Engineers, Great George-street, London, S.W. 1. Annual general meeting. 12.30 p.m.

Institution of Automobile Engineers.—Training School of Vauxhall Motors, Ltd., Luton, Beds. Luton Graduates' meeting. Paper, "Broaching and Broaching Machines," by Mr. E. Beaumont. 7.30 p.m.

Institution of Locomotive Engineers.—The Engineers' Club, Coventry-street, London, W. 1. Paper, "Railway Springs," by Mr. T. H. Sanders. 7 p.m.

Junior Institution of Engineers.—Visit to the Steel Foundry of Kryn and Laby Metal Works, Ltd., Letchworth, Herts.

FRIDAY, FEBRUARY 25th.

Institution of Civil Engineers: Birmingham and District Association.—Grand Hotel, Birmingham. Annual dinner. 6.30 for 7 p.m.

Institution of Engineering Inspection.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Economic Production of Steam by Electricity," by Mr. C. J. Wharton. 7.30 p.m.

Institution of Locomotive Engineers: Manchester Centre.—College of Technology, Manchester. Paper, "Modern Locomotive Superheating," by Mr. H. E. Geer. 7 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Waste Heat Recovery," opened by Major W. Gregson. 7 p.m.

Institution of Production Engineers.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Paper, "The Production of Cylinder Blocks in Quantities of 25, 250, and 2500 Per Week," by Mr. H. Mantell. 7.30 p.m.

Junior Institution of Engineers, 39, Victoria-street, London, S.W. 1. Lecture, "A Trip in the Norwegian Fjords," by Dr. C. M. Walter. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Literary and Philosophical Society's Rooms, Newcastle-upon-Tyne. Paper, "Loading and Unloading Facilities on Board Ship and Land," by Mr. R. J. Dodsworth. 6 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Discourse, "The Solids of Plato and Archimedes," by Professor D'Arcy Thompson. 9 p.m.

SATURDAY, FEBRUARY 26th.

Institution of Automobile Engineers.—London Graduates' visit to the Service Station of Stewart and Ardern, Ltd., Acton Vale, W. 3. 2.30 p.m.

TUESDAY, MARCH 1st.

Electrical Power Engineers' Association: Midland Division.—Chamber of Commerce, New-street, Birmingham. Lecture, "Super-Tension Cables," by Mr. Charles Vernier. 7 p.m.

WEDNESDAY, MARCH 2nd.

Liverpool Engineering Society.—9, The Temple, Dale-street, Liverpool. Paper, "The Mersey Crossings and Industrial Developments," by Mr. James Wilding. 6 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "The Corrosion of Metals at Joints and Crevices," by Mr. Ulick R. Evans. 8 p.m.

FRIDAY, MARCH 4th.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Cinematograph Exhibition. 7 p.m.

WEDNESDAY, MARCH 9th.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "The Utilisation of Gas Coke," by Dr. E. W. Smith. 8 p.m.

FRIDAY, MARCH 11th.

Diesel Engine Users Association.—Caxton Hall, Westminster, London, S.W. 1. Paper, "High-Revolution Oil Engines," by Mr. P. A. Holliday. 3 p.m.

Ex-British Westinghouse Association.—Hotel Cecil, Strand, London, W.C. 2. Ninth re-union dinner. 5.45 for 6.45 p.m.

SATURDAY, MARCH 12th.

Institution of Municipal and County Engineers.—South-Western District meeting at Bath. 12 noon.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Guest and Chrimes, Ltd., of Rotherham, ask us to announce that they have changed the address of their London office from 4 and 5, Adam-street, Adelphi, to Rooms 413 and 414, Cecil Chambers, 76, Strand, W.C. 2.

Petters Limited, of Yeovil, asks us to announce that the change of name of Vickers-Petters, Ltd., to Petters (Ipswich), Ltd., has now been officially sanctioned, and that the use of the new name is being made forthwith.

We are asked to state that on and after February 26th the London editorial, advertising and private wire departments of the *Sheffield Daily Telegraph*, the *Yorkshire Telegraph and Star*, the *Weekly Telegraph*, the *Sports Special*, the *Weekly Telegraph Novels* will be removed from 180 and 181, Fleet-street, E.C., to 200, Gray's Inn-road, W.C. (*Daily Sketch* Building). The present ground floor offices at 180–181, Fleet-street, will remain open for the reception and transmission of advertising orders, copy, proofs, blocks, editorial copy, photographs, and the supply of voucher copies and back numbers.

The Junior Institution of Engineers.—The Junior Institution will hold, on Friday, March 4th, a gathering of an unusual nature. The "Juniors" recently celebrated its forty-sixth birthday, and thus many of its original members are now "Seniors" in years, if not in spirit. In order that those may demonstrate their still youthful fervour and incidentally show the present generation of "Juniors" how the characteristic camaraderie originated in the "old days," the arrangements of the special gathering have been deputed to Walter T. Dunn, secretary for the first twenty-seven years of the Institution's history, and a few other veterans. The exact nature of the programme has not been divulged, but in view of the prominent positions which many of these early "Juniors" now occupy in the profession, some interesting engineering and other experiences may be looked for. This meeting will, it is hoped, afford special opportunity for the younger generation to rub shoulders with men who saw the birth of the Institution at the Lambeth works of Maudslay, Sons and Field, who watched over its early years, and instilled into its activities the spirit of mutual helpfulness and enthusiasm which still remains its most prominent and attractive feature.